# THE
# SANITARY ARRANGEMENT
# OF
# DWELLING-HOUSES

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*A. J. WALLIS-TAYLER.*

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# THE SANITARY ARRANGEMENT
# OF DWELLING-HOUSES

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THE

# SANITARY ARRANGEMENT
OF
# DWELLING-HOUSES

## A Handbook for Householders and Owners of Houses

BY

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# PREFACE.

Many books have been written upon sanitary science, and some of them are justly considered to be standard works upon the subject; but the prices of these publications are too often prohibitory to the general public, while the matter is treated in a style too strictly technical, and they are, therefore, interesting and instructive to purely professional readers only.

Under these circumstances, the writer has endeavoured to meet what he believes to be a want, and to embody in this little volume—in as plain and untechnical language as possible, and as concisely as may be consistent with clear and proper classification—the information necessary for the guidance of the non-professional householder, who desires to attain to such knowledge of the subject as will enable him to use his own judgment to advantage in securing proper and effective sanitary arrangements in his dwelling. If this intention has been successfully carried out, this little Handbook should find a place in every household.

The first idea of the writer was to confine himself to that part of the sanitary arrangement of dwelling-houses which comprises the Draining thereof and the various fittings requisite for that purpose. It was felt, however, that this would have restricted the work to too narrow limits, and it was determined to render the HANDBOOK more generally useful by somewhat increasing its scope. With this object in view, although the first-named portion of the subject has received the chief share of attention, other subjects—such as Ventilation, Heating, and Water Supply—have been as largely treated of as the restricted space at command would admit.

The provisions of the Public Health Act, 1875, and the Public Health (London) Act, 1891, bearing upon the sanitary arrangement of dwelling-houses, with the clauses of the Model Bye-Laws which were framed in relation thereto, have been appended, as being of interest and utility to the householder, for perusal and reference; and to these have been added the regulations of the Metropolis Water Act (1871) upon the same subject, and the Instructions to Plumbers issued by the New River Company.

LONDON, 1894.

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## CHAPTER I.

### INTRODUCTION.

THE sanitary arrangement of dwelling-houses is an all-important subject, and one, moreover, which concerns no particular section, but the public in general. It is the duty of every person to avoid residing in any house that is not drained on the best principle, and wherein the soil drains, soil pipes, branches, connections, and fittings above and below ground, are not sound, of the most approved design, and properly and effectively put together by skilled workmen, and with the best materials.

Only a comparatively small proportion even of the better classes of houses (perhaps not more than one-fifth or a quarter) are in a thoroughly sound sanitary condition, and entirely free from dangers to the health of the occupants; whilst, by reason of serious defects and deficiencies in the drainage and other sanitary arrangements, the smaller and inferior classes of houses (to the inhabitants of which loss of health is a much greater misfortune than to the wealthy, meaning as it does loss of bread) are, as a rule, more or less destructive to the health of the tenants, and are but too frequently nothing short of death-traps.

It is therefore obviously advisable that people of all classes should themselves have some knowledge of modern sanitary science, and be able to safeguard themselves against being trapped into taking houses with faulty drains, and also be able to judge of the relative advantages of the various fittings and appliances, which are legion, and not be forced to commit themselves blindly to the guidance of some so-called sanitary engineer, who may have personal motives for his recommendations, without any real care or anxiety as to their actual merit or suitability.

To ensure a dwelling-house being healthy, it should be so constructed as not to be readily influenced by external changes of temperature. It should be dry, not liable to become over hot in summer or over cold in winter; and, above and before all other things, it should be fitted with an approved modern system of drainage and other sanitary appliances.

In choosing a district or suburb of a town or city for residential purposes, it is desirable, in addition to having a thorough inspection made of the drains of the particular house it is proposed to occupy, to also inquire into the character and conditions of the public sewers in the locality (a precaution too frequently neglected), as if these be badly constructed, ill ventilated, and insufficiently flushed, the comparatively perfect condition of the house-drains will be of but little avail. The public sewers more frequently than not consist of drain-pipes (not always of good hard stoneware, well glazed and impervious to moisture) carelessly laid and jointed with clay. In a work on "Sanitary Engineering," published in 1878, Mr. Baldwin Latham, alluding to this abominable practice, says: "The material most commonly used for jointing pipes is clay, which is one of the worst materials that could be found for the purpose. We seek the most impervious materials wherewith to construct our sewers, and often spoil their effect by the indifferent manner in which we put the materials together. A soft yielding substance like clay is about the worst possible material that can be used for jointing pipes, as it must be clear that clay is liable to get washed out of the joints both from the action of water escaping from the pipe, or of water flowing from the subsoil into the pipe. Apart from this, a soft yielding material, when used for jointing, notwithstanding however perfectly the work may be performed, will lead to failure, as the weight of earth covering the pipes causes the clay to be squeezed out of the lower part of the socket of the pipe, leaving an aperture in the upper part through which sewer air and sewage may escape, or water and sand be carried from the subsoil into the sewer. These serious defects in jointing not unfrequently lead to the disturbance of the line of pipes and destroy the regularity of their bed."

Where brick sewers are in use the inverts are also very frequently constructed dry, in order to admit of the subsoil water passing into the said sewers; this is an equally reprehensible system, and should be invariably condemned.

When pipe sewers are laid with leaky joints, and brick sewers with dry inverts, two very objectionable things result; viz., firstly, the subsoil water passes into the sewer, and there is in consequence a vastly greater amount of sewage to be dealt with than was estimated for; and secondly, the leakage from the sewers impregnates and saturates the soil with sewage. The first of these is objectionable to the householder, as frequently resulting in flooding; the second may be the cause of violent outbreaks of diphtheria and fevers.

In addition to forming the main sewers with defective joints, it is not uncommon for storm or surface water sewers, with similarly defective joints, to be laid at a less depth than the main sewers; consequently the storm-water soon finds its way through the trenches and passes into the latter, the results of which will be obvious.

It is important, therefore, to choose as a residential district one wherein there is a good system of main sewers laid with perfectly water-tight joints, and of storm or surface-water pipes or sewers. In cases where the soil is of an impervious nature, the provision of a separate system of subsoil drains is imperative, and these should be laid at a lower level than that of the main sewers, and provided with laterals where requisite, as a subsoil drain constructed down the centre of a street cannot possibly be expected to have any appreciable effect upon the soil at a distance of fifty or sixty feet therefrom.

Finally, before proceeding to deal categorically with the different systems, appliances, &c., &c., with which it is necessary and desirable that the householder should become familiar, it must be observed that a good system of house-drainage will be of but little avail unless due care be taken to keep it in proper order, and the strictest cleanliness be rigorously maintained.

An acquaintance with, and an observance of, the following rules should be insisted upon :—

The water cisterns should be kept thoroughly clean, and be provided with closely-fitting covers.

A cistern for supplying water for domestic use should not be connected directly with any water-closet or drain.

The admission of gases from the public sewer to the house-drains should be guarded against by a proper intercepting trap with an inspection chamber, and the drains efficiently ventilated by means of an air inlet and an upcast ventilating shaft.

The drains throughout should be maintained in a perfectly water-tight condition, and frequent flushing, and cleansing of all closets, sinks, and urinals should be carefully and regularly attended to.

All sanitary fittings should be kept in good order, and be immediately replaced when worn out.

Water-closets should be flushed before and after use, and great care should be taken to see that no large masses of paper, hair, rags, fluff, or other matter likely to be conducive to creating stoppages in the branch pipes, soil pipes, or in the soil drains, be passed down them.

Dust-bins should be made of material impervious to moisture, preferably of galvanised wrought iron, with properly fitting covers. Vegetable matter should not be placed in the dust-bins, but burned.

Disinfectants may be advantageously employed when a dust-bin has been emptied, but their use in water-closets, &c., will not counteract the ill-effects of imperfect sanitary appliances or filth.

An efficient system of ventilation should be provided.

# CHAPTER II.

## SITE OR POSITION.

THE question of the site or position of a house embraces the nature of the soil upon which it is built, the situation in which it is placed, and finally the aspect or the prospect which it commands.

Most unquestionably a gravel soil is the best to choose for a site for a dwelling-house. Where gravel soil cannot be obtained, the next best is chalk. Clay soil is usually damp and unwholesome, and undesirable in every way. Where a dwelling-house must of necessity be built upon such soil, careful and thorough subsoil drainage should be resorted to. Made up ground should, as a rule, be avoided.

**Aspect.**—The aspect of a dwelling-house, although of less vital importance than that of soil, of proper construction, and of a carefully planned sanitary system and arrangement, is notwithstanding a factor having no small influence upon the health and comfort of the residents, and whenever possible a south-easterly one should be chosen.

**Situation.**—This is likewise a matter requiring the exercise of great care and judgment. The best situation for a country house is on the gentle slope of a hill, at a sufficient elevation to be well clear of any miasmata rising from the lower grounds, and to secure a good fall for the drainage. In fact, so long as the hill is not too steep, the nearer the top the better, provided the requisite shelter can be obtained. An observance of the growth of the trees in a neighbourhood will indicate the direction of the prevailing winds, the constant pressure of the latter causing the trees to bend all one way, and the young twigs and leaves to grow more freely on the side farthest from that against which the wind most constantly impinges, where they are as a rule more or less damaged and destroyed.

The summit of a steep hill is bracing, but, being exposed to all winds and weathers, is extremely trying to those in delicate health, not to speak of the difficulty of access. The side of a steep hill is likewise objectionable, as houses built in this position are liable to settlement and consequent cracking and damage to the walls, ceilings, &c., unless very special precautions be observed when building. Moreover, houses so situated are not infrequently damp, and the chimneys are as a rule incurably smoky.

The bottom of a hill is even still more objectionable, as all the water from the higher ground runs into the foundations and dampness ensues as a natural consequence. Besides, in hot weather it will be found uncomfortable and unsanitary by reason of the stagnation and want of a free circulation of air. The one advantage of this position is that it is easy of access.

Finally, it is well to bear in mind, when choosing a site, what has been tersely put by an old authority, viz.: "When choosing a house, we should chiefly choose a wholesome air, for air is a dish one feeds on every minute, therefore it need be good."

The choice of position for a suburban residence will of course have to be governed by a variety of circumstances, but the general principles above enunciated should be borne in mind.

Town houses are as a rule selected on account of their position with respect to some business or fashionable neighbourhood, and the occupier will have as a rule to content himself with paying due attention to the drainage and other sanitary arrangements.

# CHAPTER III.

## MATERIALS FOR WALLS AND ROOFS OF DWELLING-HOUSES.

**Walls.**—The walls of dwelling-houses are usually constructed in this country of either masonry or brickwork. When of masonry, the walls are either of cut stone-work, or of rubble work or moëllon; the first, on account of its expensive nature, being usually only employed on large public or other buildings. Brickwork is by far the most common material for the walls of dwelling-houses, more especially in cities and large towns.

Brickmaking is perhaps the most ancient art in existence, and dates back to the year 2247 B.C., when we read in Holy Writ of the men on the plains of Shinar, who said, "Go to, let us make brick, and burn them thoroughly. And they had brick for stone, and slime had they for mortar." These men of Shinar laid up their bricks with slime (bitumen), and succeeded in producing very good work, if the hypothetical remains extant to this day testify anything, and were decidedly ahead of our nineteenth-century jerry-builder, who uses, when he can, half-burned bricks, and sets them up with mortar consisting principally of road-scrapings or worse, and whose work usually disappears in the course of a few years, or is nursed into a more prolonged but sickly existence only by the help of constant repairs.

It is far beyond the scope of this little work to enter with any degree of fulness into the subject of brickmaking, about which, indeed, volumes might be written; but it will not be out of place or unuseful to insert here a few notes thereon, as the materials of which the outer or main walls of a dwelling are constructed has an important bearing upon its sanitary condition. Bricks for building walls may be designated under the heads of marls or malms, stocks, and place bricks. The first of the above-named are of a bright uniform yellow colour, and are adapted for cutters for arches, their fine texture rendering them suitable for rubbing. The second quality of marls are used for gauged work and the facing of walls. Stocks are both of a red and grey colour, in accordance with whether they are kiln or clamp burned. Place bricks are ones which have not been properly burnt, and being of an inferior quality are only fit for the interior, or for purposes of building where soundness is not a desideratum. The usual dimensions of ordinary London stock bricks are $8\frac{3}{4}$ in. by $4\frac{1}{4}$ in. by $2\frac{1}{2}$ in., but they are supposed to be, and are spoken of as being, 9 in. by $4\frac{1}{2}$ in. by $2\frac{1}{2}$ in. Their weight is about $6\frac{3}{4}$ lbs. each. In country places these dimensions are frequently greatly exceeded. The chief qualities to be sought for in good bricks are, firstly, complete soundness, that is, entire absence or freedom from flaws or cracks, so as to enable them to withstand the maximum degree of strains and pressures; secondly, perfect regularity in size and shape, so that they may occupy their true position in the courses.

The walls, whether composed of masonry or brickwork, must be properly and securely bonded, and effectively and solidly put together with good mortar, made with the best lime and clean sharp sand, or some equivalent material, with good quality Portland cement neat, or with good quality Portland cement mixed in suitable proportions with clean sharp sand.

**Roofs.**—The best covering for the roofs of dwelling-houses are either slates or tiles. Slates, if of good quality, form a more desirable material for roofs than tiles, and in order to make a thoroughly sound efficacious job, the roof should be first covered with match-boarding and a layer of felt or Willesden paper. When tiles are used great care must be taken in their selection, otherwise considerable numbers of them will be split up by the frost in the winter time, thus necessitating constant repairs. An objection to tiles is the liability to snow and rain being blown under them, and thus penetrating to the interior of the roof. Several patent forms of tiles are, however, in the market, giving more or less satisfaction, and their respective inventors claim that by their use a perfectly weather-resisting roof, impervious to wind, rain, or snow, can be formed. Amongst these mention may be made of Phillips's Patent Lock-jaw Roofing Tiles, which have on each of the four sides a system of grooves with corresponding tenons, formed so that each tile locks into others on each side top and bottom, the bottom of top tile butting against or locking into its corresponding lower one. These tiles form an excellent roof, and have stood some severe tests during the ten years or so that they have now been before the public. They are in use upon a number of large public buildings, and also of villa residences, &c., in the neighbourhood of London and elsewhere.

**Damp-proof Courses, &c.**—Special attention should be paid to the insertion of damp-proof courses. If these be omitted altogether, or if where present they are improperly laid, damp will be drawn up the walls by capillary attraction from below the foundations.

When damp makes its appearance in the walls owing to imperfect damp-proof courses, or from their total absence, it is useless to cement them internally and externally, or to line them with match-boarding; this, by preventing evaporation, only aggravates the evil. There is but one lasting remedy, and that unfortunately is one difficult to apply; the walls must be cut and a proper and efficient damp-proof course be inserted.

Damp-proof courses formed of single courses of slates are useless, and those formed of felt are liable to become so after the lapse of a few years. A proper damp-proof course can be formed of two courses of slate breaking joint and properly bedded in cement, of sheet lead, of asphalte, or of some vitrified damp-proof course, such as Taylor's patent. These latter afford the additional advantage of acting as ventilators.

It may sometimes happen that damp walls are occasioned by the external soil being raised to a higher level than the damp-proof course. This should be remedied at once, and a wall be built to keep back the earth, and so as to form a properly drained and ventilated area.

In the case of dwelling-houses having basements intended to be used as living rooms or for storage purposes, it is desirable to provide a second damp-proof course just above the ground level, in addition to the one just above the footings, and also a vertical damp-proof course extending from the first to the second of these horizontal damp-proof courses. This vertical damp-proof course may be formed of asphalte or cement, and should be about two inches in thickness, and it should be inserted in the body of the wall as the work proceeds.

Damp-proof courses should also be invariably inserted in a chimney just above the roof. This latter precaution is very generally neglected, with the natural result of injury to both the ceilings and walls of the upper rooms.

A space of at least three inches should be left between the underside of the joists and the ground in all basement living rooms, and where a ventilating damp-proof course is not used, air or ventilating bricks, or passages or ways fitted with iron gratings, should be inserted in the back and front walls, so as to admit of a free current of air passing beneath the floor.

Where a dwelling-house has to be built in an excessively exposed situation, either all the walls, or at any rate that which is the most exposed, should be constructed of hollow or ventilating bricks, or be covered with slates or tiles, or, what is far preferable to weather-slating, be built hollow, as shown in Fig. 1.

Hollow walls are by no means an invention of modern times; they were known to, and used by, the Romans in cases where the exposed situation of the building demanded it, and walls constructed of inferior bricks, or porous soft stone were liable to be subjected to driving rain. Vitruvius advised that in ground-floor apartments or rooms the first coat of stucco at a height of three feet from the pavement, should be of potsherds and not of sand, and that a thin wall be built on the inside in such a manner as to leave a flue or cavity between for the free circulation of air. In cases where want of space did not admit of this arrangement, tiles two feet square were to be placed one over the other in front of a flue left in the wall, and were afterwards to be plastered over or stuccoed. A suitable drain or channel was also to be provided to receive any moisture that might run down the flue or hollow portion of the wall.

In the construction of a hollow wall it is well to employ some pattern of vitrified non-absorbent bonding bricks. These bonding bricks, by reason of their peculiar form, render the passage of water from the outer to the inner wall along the said bricks an impossibility, as to do so it would have to ascend an angle of forty-five degrees. If properly built, a good hollow wall affords great strength, and the inner portion cannot become damp. Fig. 1 shows a portion of a hollow wall, illustrating the use of the above-mentioned vitrified damp-proof course and bonders.

In the drawing the thin portion of the wall is shown as being placed on the inside. The most usual practice, however, is to reverse this and to place the said thin portion of the wall upon the outside, or to construct both portions of equal thicknesses.

A layer of concrete of a minimum thickness of six inches is required by the Building Act to be laid over the whole site of a new dwelling-house, except where such house is being erected upon a gravel, sand, or virgin soil. This should, however, be invariably done on all soils, and where a new house is being built the layer should not be less than nine inches in thickness at the least, and cement and not lime concrete should be employed.

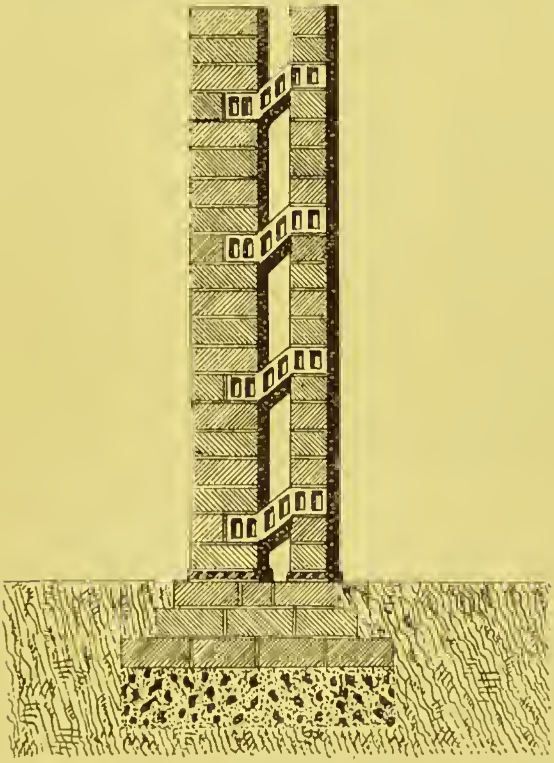

Fig. 1.

# CHAPTER IV.

## SOIL DRAINS.

FIG. 2 is a plan showing the proper method of draining a semi-detached or detached house. Wherever practicable the soil-drain from a dwelling-house to the public sewer should be situated outside the house, as shown in this plan. The soil-drain should consist of cast iron or best stoneware pipe six inches in diameter, and be laid with a fall of about four inches in ten feet, or one in thirty. That gradient will give a velocity of about five feet per second, and in no case should the velocity be less than three feet per second. A separate drain for the surface water, also consisting of a pipe of cast iron or stoneware, but only four inches in diameter, should be provided where the dual system is in use.

Iron pipes afford the advantage over stoneware pipes of being in longer lengths, and consequently having less joints. On the other hand, however, they are much more readily acted upon by various acids. According to the results of tests applied by Dr. Kämmerer, of Nuremberg, to ascertain the effect of various acids on the materials employed in the construction of drainsand sewers, as given in the *Builder*, glazed stoneware or earthenware pipes withstood their action far better than any other kinds which were subjected to the tests, which latter were made as follows :—" Pieces of the various substances to be tested were left for a certain length of time in a solution of one per cent. of sulphuric, muriatic, and nitric acid or ammonia, and their loss in weight was accurately observed. The results arrived at showed that ammonia exercises an effect of such slight importance that its action can, as a rule, be disregarded. The destructive properties of muriatic and sulphuric acid were, however, fully demonstrated. In the various kinds of brick the loss was from ·02 to 23·50 per cent. The losses in the

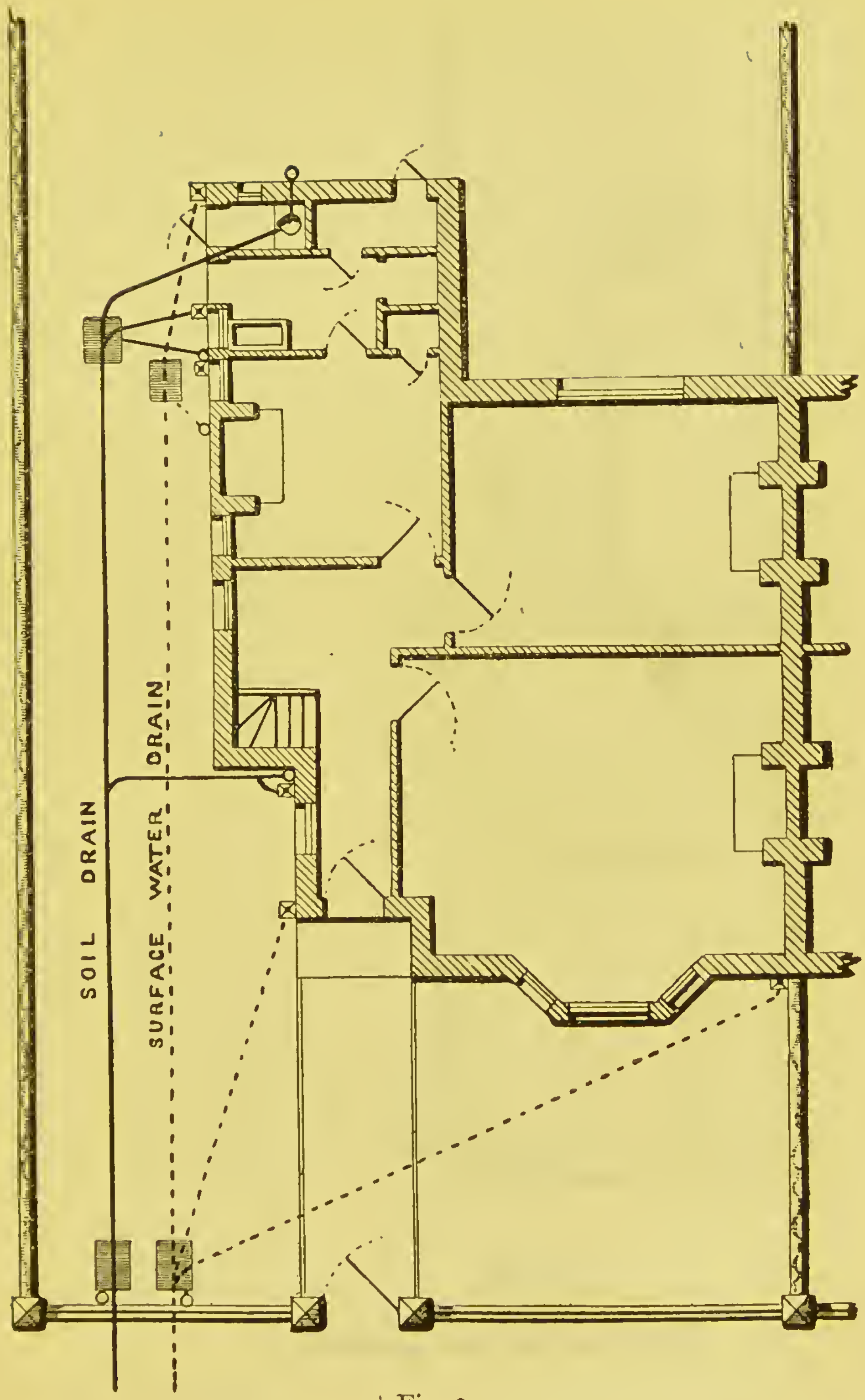

Fig. 2.

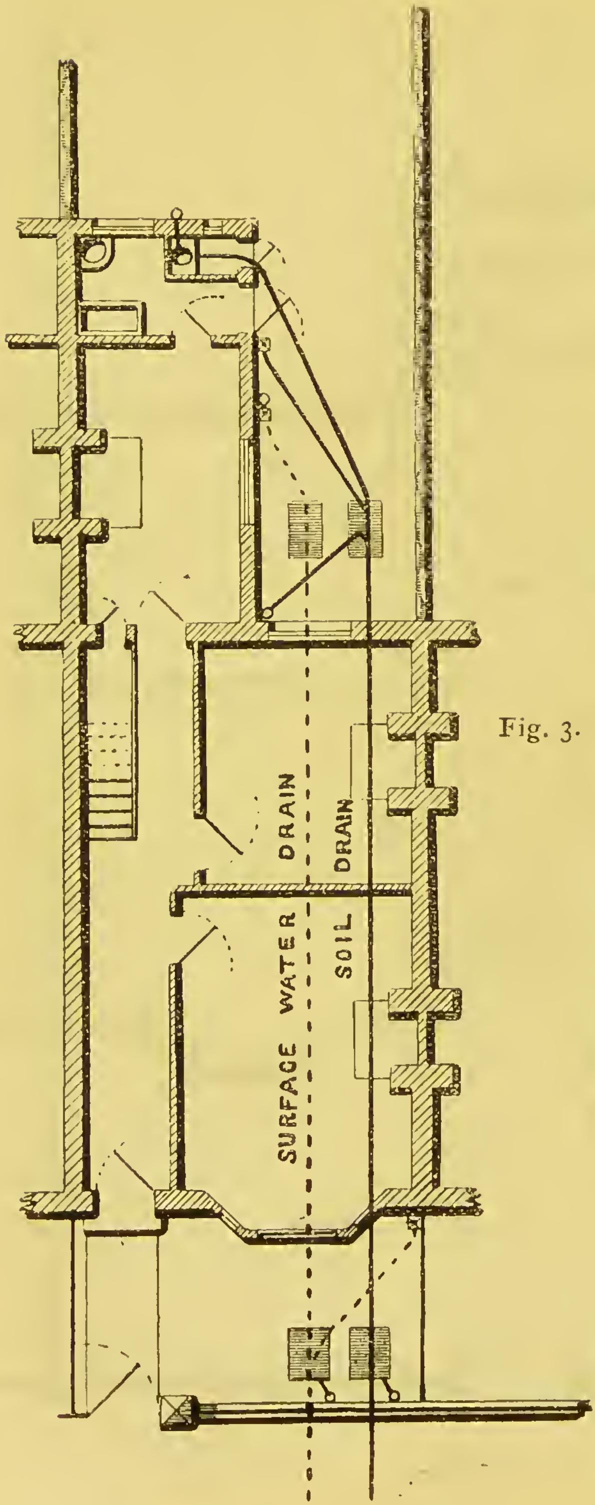

Fig. 3.

instances of concrete and cement pipes varied from 13·74 to 37·11 per cent. Glazed pottery-ware pipes withstood the influence of the acids better than any of the other kinds tested, their loss being from 0·13 to 0·17 per cent."

When iron pipes are employed the joints should be run with lead, and they should be thickly coated with Dr. Angus Smith's solution, or some equivalent, in order to prevent their oxidising through contact with the sewage.

Clay or earthenware pipes were used for drains, &c., by the Romans. Their pipes had contracted ends, which entered the sockets or enlarged ends of those adjoining.

Stoneware or earthenware pipes intended for use as soil-drains should be of good quality, and not, as are sometimes used, for the sake of cheapness, of a porous nature, through which water can freely percolate.

The joints of stoneware pipes must be made perfectly water-tight, and there are numerous patent joints of more or less efficiency in the market. A simple and tolerably effective joint is that known as the "Stanford" joint, the patent for which has expired. This joint, which can be easily made on the ground by the builder, will be found fully described, together with some types of patent and other special joints, in the chapter devoted to "Pipe and other Joints." The drains should be laid on a good bed of cement concrete, of at least six inches in thickness.

When it is absolutely necessary, as in the case of a terrace house, that the drains should pass directly beneath the latter, they should be laid as shown in the plan Fig. 3, and should be covered all round with a layer of at least six inches of good cement concrete, as shown in Fig. 19. This, however, does not do away with the importance of making water-tight joints at the junctions of the lengths of pipe. The concrete is intended to provide a rigid foundation and bed for the pipe, and to form a general protection for it, and is not for, nor does it of necessity make the drain water-tight. The drains should be laid in perfectly straight lines. A suitable intercepting trap should be provided between every drain from a dwelling-house and the public sewer, and such intercepting trap should be situated outside, and at as great a distance as possible from the external wall of the said dwelling-house, and as close as possible to the junction of the said house-drain with the main drain or public sewer. An inspection or intercepting chamber should, moreover, be placed as near as possible to the above-mentioned intercepting trap on the side nearest the house, so arranged as to afford means of access to the drain, and this chamber should be closed by a suitable air-tight man-hole cover, and provided with a ventilating pipe or shaft, which should be carried up to as great a height as practicable, and provided at its upper or free extremity with an air inlet ventilator, fitted with a mica flap-valve or valves, as more fully described in the following chapter.

# CHAPTER V.

## INSPECTION OR INTERCEPTING CHAMBERS.

INSPECTION or intercepting chambers are simply subterranean chambers of a suitable depth, in accordance with that of the drains in connection with them. The walls of an inspection chamber are usually built of bricks, and the floor is provided with an open channel pipe, preferably of white glazed stoneware, leading from the end of the soil-drain to the intercepting trap at the commencement of the connection to the main sewer, suitable connecting channel bends being also provided where more than one soil-drain discharges into the same chamber. The floor should be of bricks laid in cement, or of good cement concrete, and a cement benching should be provided at the sides of the chamber, or, what forms a far neater job, the floor may be formed of blocks of imperishable stoneware (having the channel or channels formed in them), and the side walls of glazed stoneware ashlar.

The upper part of the chamber must be provided with a man-hole fitted with an air- or gas-tight door or cover, which can be opened so as to admit of access being gained to the interior of the said chamber when desired. Several excellent patterns of man-hole doors or covers, so arranged as to form perfectly gas-tight joints, are obtainable. The upper part of the chamber should communicate with the atmosphere through a ventilating pipe or shaft, fitted at its upper end with an inlet ventilator. This ventilating pipe should be of stoneware or lead, and of smooth and even bore so as to offer the least possible obstruction to the passage of air therethrough. Iron pipes are objectionable owing to their liability to rapid corrosion caused by the moisture resulting from the condensation of the saturated air from the drains continually trickling down internally. Galvanising only forms a temporary safeguard against this corrosion, and iron pipes are apt to become partially stopped up, and the free passage of air impeded, by the rust peeling or scaling off and falling to the bottom of the said pipes.

Where the separate or double system is in use, as shown in the plans, Figs. 2 and 3, a similar inspection chamber should be provided in the outlet end of the surface-water drain. It is desirable to also provide inspection chambers at the rear or other ends of the soil and surface-water drains, as shown in the said plans.

In the latter case the rear chambers must be connected with ventilating pipes or shafts, carried up the outside walls of the house, and for a distance of three or four feet higher, and having at the termination of their upper ends suitable cowls or exhaust ventilators.

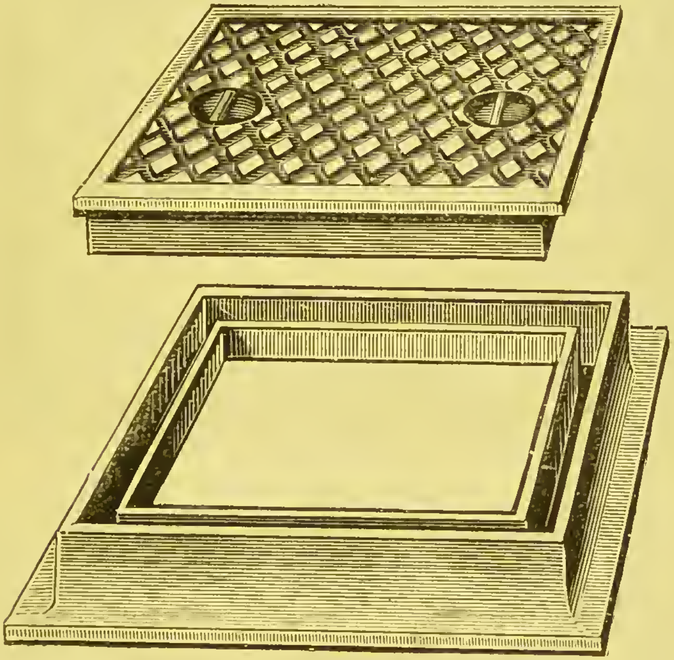

Fig. 4.

**Man-hole Covers.**—These are made in a great variety of patterns. The following examples show the principal methods of forming the air- or gas-tight joints.

Figs. 4 and 5 are two man-hole covers designed and made by Messrs. J. Tylor and Sons, Limited, London. That shown in Fig. 4 is intended to form an air- or gas-tight joint by means of grease or sand. The grease or sand is placed in the groove shown in the frame casting, into which a rib or flange upon the cover dips so as to form an hermetically-sealed joint, and to render the passage of air or gas an impossibility.

Fig. 5 shows a hinged cover wherein the joint is formed by a packing of indiarubber, which is let into a groove in the frame, and against which a rib or flange upon the cover is adapted to bear when the said cover is closed, so as to form a perfectly tight joint, as clearly shown in the vertical longitudinal section. The cover can be securely locked in position by means of the screw or stud shown in the drawing, and in the head of which a square hole or recess is formed to receive a key.

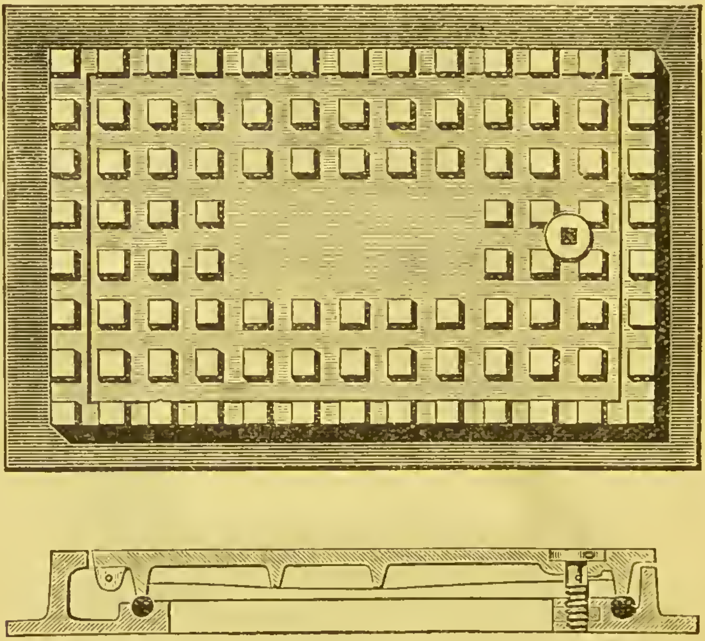

Fig. 5.

Fig. 6 shows a patent air-tight man-hole cover designed by Mr. F. Dyer, London. The air- or gas-tight joint is formed by means of a hollow india-rubber ring or packing, inserted in this case in a groove or channel provided on the underside of the cover, and adapted to bear against a rib, flange or knife-edge formed on the frame. By forming the indiarubber packing-ring hollow, the advantages of an extra elastic air or pneumatic cushion-joint is ensured.

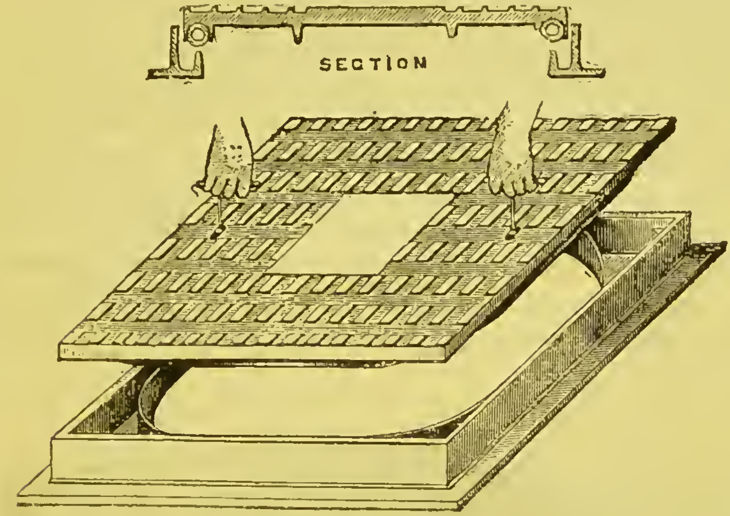

Fig. 6.

In the man-hole cover, illustrated in Fig. 7, the air- or gas-tight joint is obtained in a novel manner, and forms the subject matter of a patent taken out by Mr. John Jones, of Chelsea. In the pattern of cover illustrated in the drawing two seals are provided, the first or uppermost of which forms a

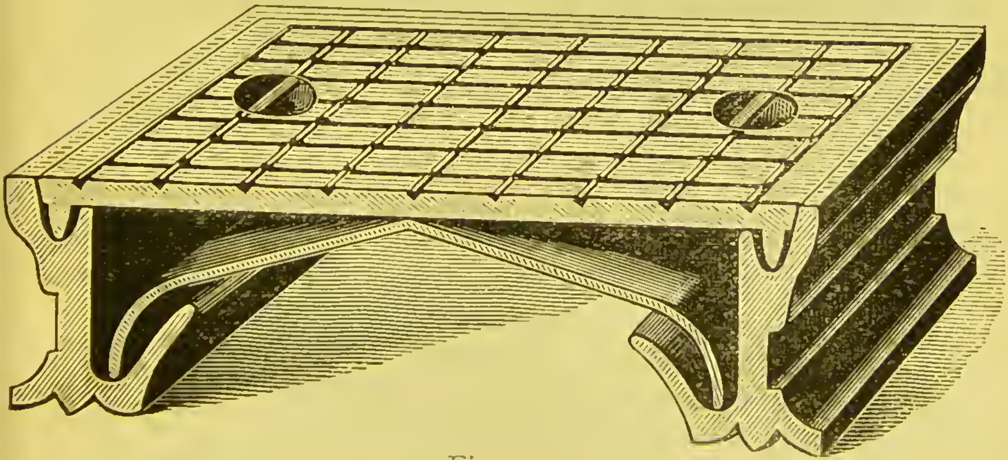

Fig. 7.

secondary or auxiliary seal, and is obtained in the usual manner by a rib or projection on the underside of the cover adapted to dip into a groove or channel provided in the frame, the joint being formed by means of sand, grease, or otherwise. The second or lower or main seal is formed by the curved or cambered plate (shown in the drawing) on the inside of the cover, which, as will be seen, dips into a deep channel cast on the inside of the frame. This main joint or seal is automatically formed by the evaporation taking place in the man-hole. The air passing over the liquid contained in the drains becomes saturated with moisture, and, being at a comparatively high temperature, becomes condensed on contact with the cold plate of the cover, and the resulting moisture, owing to the shape of the latter, is readily conveyed to the channel or groove, where it forms a perfectly air- or gas-tight hydraulic seal round the edges of the said curved plate which dip into the said channel.

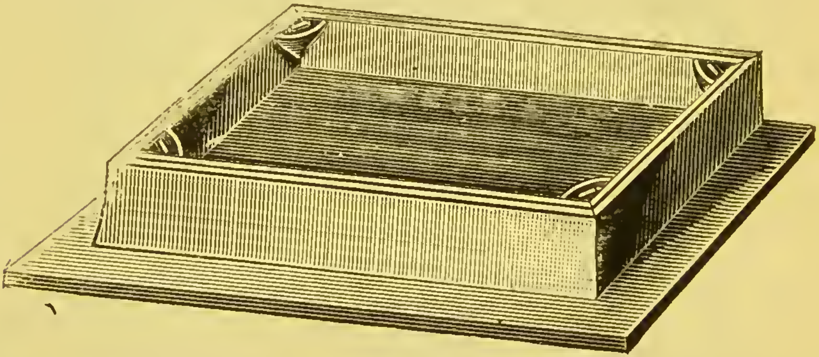

Fig. 8.

The underside of the frame is so formed as to enable a good bedding in cement to be obtained.

Several patterns of this double-seal man-hole cover, to suit varying requirements, are made by Mr. Jones, and he has at various times received gold medals, awards, and certificates. The cover is extensively used on Government works, and in cases where saving in the first cost is not an object of paramount importance, no better man-hole cover could be employed for house-drains, as the automatic action of the main seal, which takes place so long as any liquid be passing through the drains, ensures the constant existence of a gas-tight joint, and obviates leakages which might otherwise occur through badly made, or from want of renewal of worn-out joints.

Fig. 8 shows a cover designed by Messrs. Winser and Co., Pimlico, and intended especially for the man-holes of chambers situated inside a house. The cover, as will be seen from the drawing, is formed hollow or box-shaped, and is adapted to fit inside an extra deep frame. This permits of the said cover being filled in with cement, tiles, or other material similar to that of the flooring, so as to be practically undiscernible therefrom, and to afford, moreover, a firm footing, and avoid the accidents which might otherwise occur through slipping upon the exposed surface of an iron cover.

**Fresh-Air Inlet Ventilators.**—These are usually metal or earthenware boxes fitted with gratings, or perforated metal fronts, and a mica valve or valves, arranged to open inwardly so as to admit of a supply of fresh atmospheric air passing into the drains, but to close upon the slightest pressure from inside, and so prevent the escape of any foul air or gases from the said drains. In a patent inlet ventilator, also the invention of Mr. Jones (see Fig. 9), the mica flap valves are arranged to open like a double door, and it is claimed by the inventor that they are extremely sensitive, inasmuch as they are pivoted on an axis which is vertical in one plane, but diverges slightly from the vertical line at its upper end. By this means the direct weight of the valve has not to be overcome when opening, each part thereof having merely to turn on its hinge or pivot like a door, whilst the inclination of the axis is sufficient to insure the prompt closing of the said valves immediately on the slightest manifestation of a tendency to a return current of the foul air, and thus to

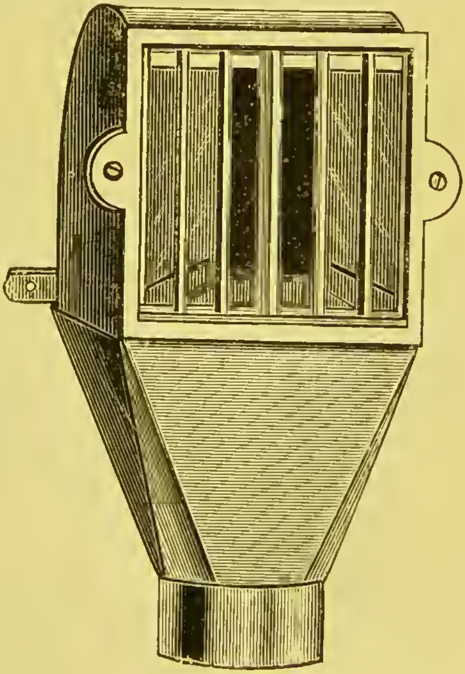

Fig. 9.

prevent any escape thereof into the atmosphere. Guards or stops are provided in order to prevent the valves from opening too far back. These valves also open immediately to the full extent, and thus afford the advantage of giving a full way of four inches for the admission of air.

Figs. 10 and 11 show inlet ventilators, having perforated diaphragms, arranged for vertical and horizontal ventilating pipes, manufactured by Messrs. Kite and Co., London.

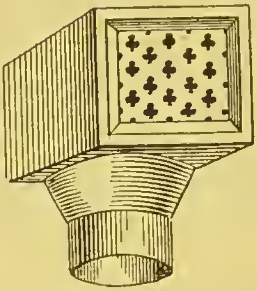
Fig. 10.

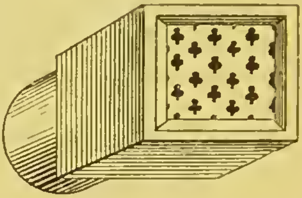
Fig. 11.

Figs. 12 and 13 show two forms of mica flap valve ventilators, made by Messrs. Robert Boyle and Sons, Ventilating Engineers, London, which are of a different pattern to those hereinbefore described. Each of these ventilators is fitted with a single mica flap valve pivoted horizontally at its upper extremity so as to swing inwardly for the admission of fresh air (as indicated by the arrows), and outwardly against the grating for preventing the emission of sewer gas from the drain.

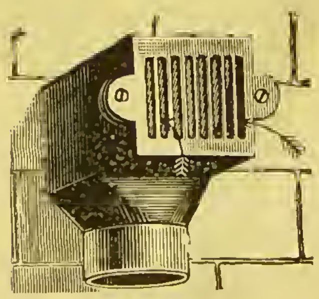
Fig. 12.

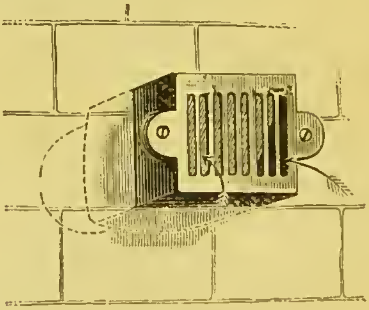
Fig. 13.

Fig. 14 is a vertical central section through an intercepting or inspection chamber, designed by Mr. Jones, and intended more especially for the soil drain of a dwelling-house in cases where an extra deep man-hole is required. At the bottom on the left-hand side is shown the syphon, or intercepting trap, communicating with, and at the same time disconnecting, the house drain from the public sewer. Jointed to this same syphon or intercepting trap is an open channel, above which is placed one of Jones's patent air-tight arched condensation covers and frames; on the right-hand side of this open channel, and jointed to the same, is a ventilating or junction pipe to convey fresh air directly into the drain by means of the reduced arm which is connected to a vertical pipe or shaft, rising to about eight or ten feet above the ground level, preferably supported against the wall of the house, or other wall convenient thereto, and having fixed on its upper end a fresh-air inlet ventilator with a four-inch full way for air. The top of the man-hole, or intercepting chamber, may be covered either by an air-tight

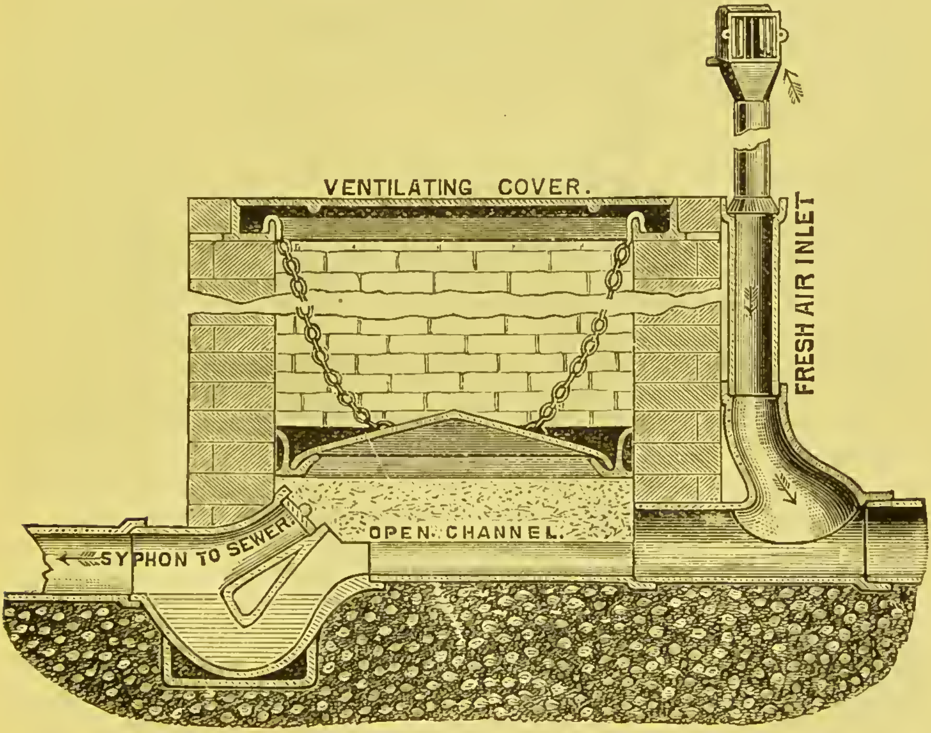

Fig. 14.

cover, or preferably by a ventilating cover of any suitable description, as the lower cover effectually keeps down all foul gases.

For ordinary man-holes a cover, similar to that shown in Fig. 7, is placed at the ground level, and the lower cover is dispensed with. In this case the ventilating pipe or shaft may be connected with the upper portion of the man-hole, and not to an arm on the soil drain, as shown in Fig. 14.

In the arrangement of an intercepting or inspection chamber (Fig. 14A), lately devised by Mr. W. Sykes, C.E., late surveyor to the Fulham Vestry, the use of open channel pipes in the floor of the soil chamber is dispensed with, and in their place he employs a special interceptor or disconnector trap (patented), having access holes or apertures for cleansing or clearing purposes hermetically closed by doors or plugs, and provided with an arm or arms for branch drains. The ventilating pipe or shaft is connected directly to the drain, and as no sewer gas can gain access to the chamber, the man-hole may be fitted with a ventilating cover.

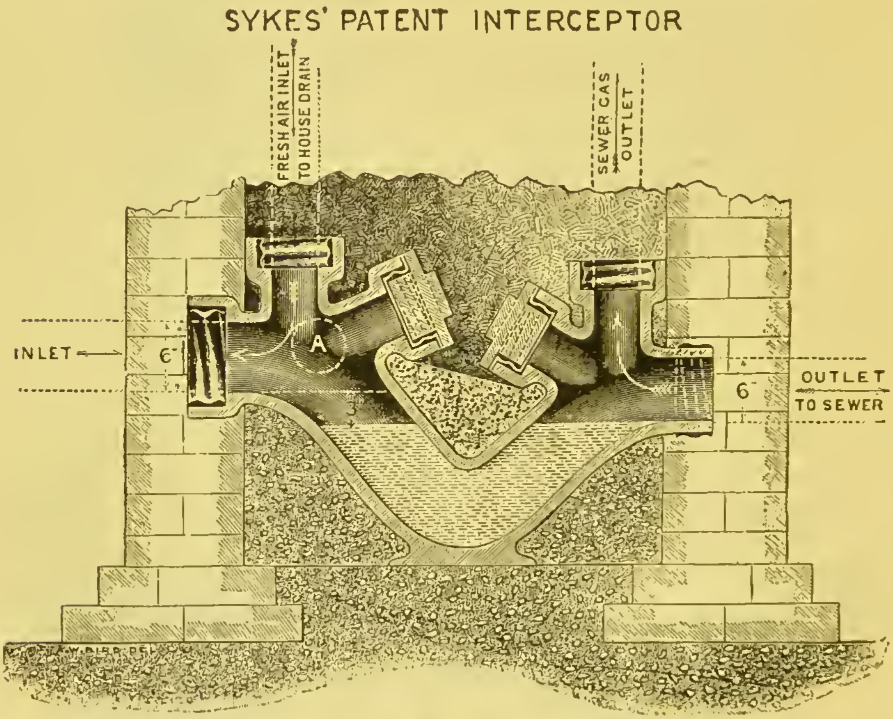

Fig. 14A.

An advantage claimed for this system is the impossibility of any flooding of the chamber taking place should the outlet to the sewer become choked up, such as may result when open channel pipes are employed. In the latter case, unless an intercepting or disconnecting trap with a relief valve capable of being actuated through a chain or rod from the top of the chamber be employed, the entire contents will have to be baled out before access can be obtained to clear the passage into the sewer.

With Mr. Sykes's interceptor or disconnector, all that is required in case of stoppage is to descend immediately into the chamber, remove the door or cover from the access-hole or aperture, and clear away the obstruction in the usual manner.

It is most desirable, although not absolutely essential, that intercepting or inspection chambers should also be provided at the rear of the building in connection with both the soil and surface-water drains, as shown on the plans, Figs. 2 and 3. The front inspection chamber affords means of ready access to the intercepting or disconnecting trap, and also to the drain on both the house and sewer side of the chamber, and the rear inspection chamber not only admits of access to the drain for purposes of inspection, but also for cleansing and flushing.

Sir Robert Rawlinson, K.C.B., late chief engineering inspector to the Local Government Board, expressed the following opinion respecting the absolute necessity of internal house drains being made absolutely water-tight, being provided with inspection or intercepting chambers, and being properly trapped at their junctions with the main or public sewer, viz.: "If houses must have internal drains they must be absolutely air and water-tight, and only have communication with main sewers by discharging sewage through an interception chamber with intercepting traps outside the external walls."

# CHAPTER VI.

## Soil Pipes.

Soil pipes—that is, the pipes for forming connection between the branches from the water-closet basins, and the house or soil drain—should invariably, when practicable, be placed externally to the walls of the house. A soil pipe should be of from three inches to four inches in diameter, according to the number of closets connected therewith. The best material for a soil pipe is undoubtedly lead, and the joints should be carefully wiped. A lead pipe has a smooth and even internal surface, and presents no obstructions to the passage of the soil; the metal, moreover, is not acted upon injuriously to any appreciable extent thereby. The upper portion of the pipe, however, is liable to become thin after a certain period owing to the creep of the lead. Iron soil pipes are also frequently employed; the joints of these should be made by being run with lead and properly caulked, or rust joints may be used. The rapid corrosion that takes place in iron soil pipes placed in exposed positions, unless kept well painted, is a serious drawback to their use.

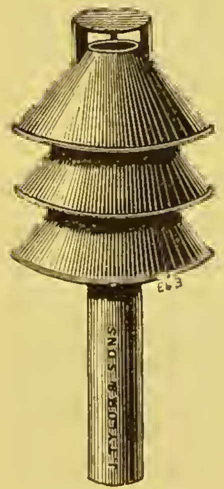

Fig. 15.

The soil pipe may, when practicable, be carried up in its full diameter to a height of a couple or three feet above the roof of the house for purposes of ventilation. Great care should be taken in this case to see that the termination of the said soil pipe is quite clear of all windows, and that there be no bend or angle except where absolutely unavoidable, in which case it should be as easy or slow as possible. For every bend that the current of air has to pass round there will be a loss of from five to ten per cent. (owing

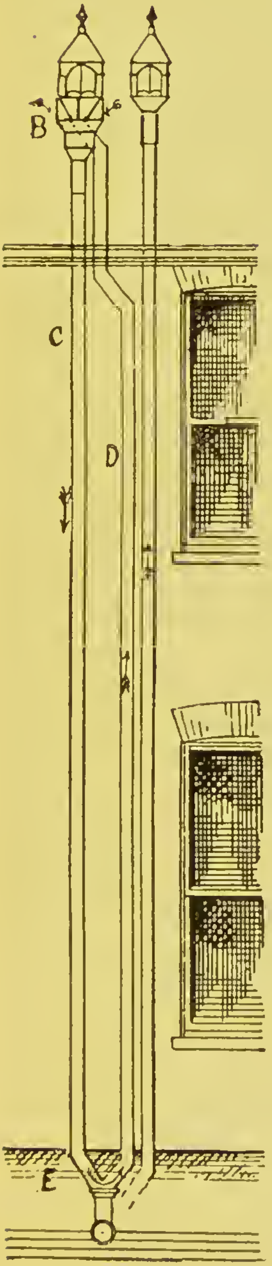

Fig. 16.

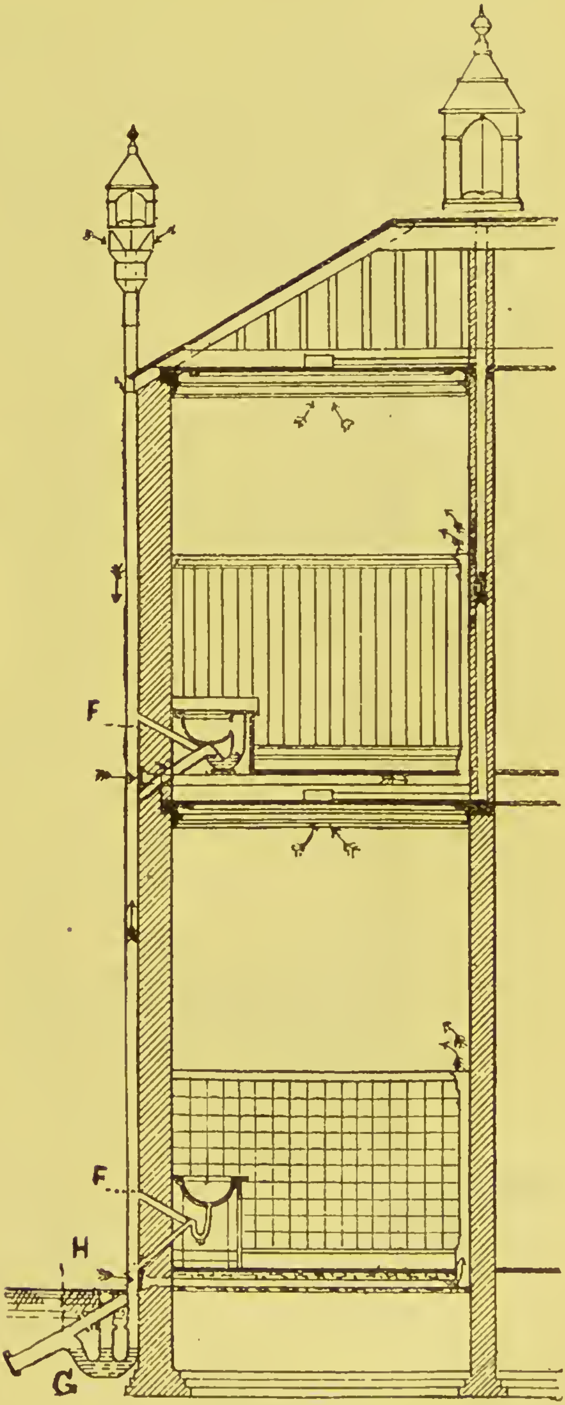

Fig. 17.

to increased friction) in accordance with the degree of sharpness of the said bend. In no case whatever should a rain-water pipe be arranged to act as a ventilating shaft for a soil pipe, as, if it be, foul gases from the latter will inevitably find their way into the house through the eaves.*

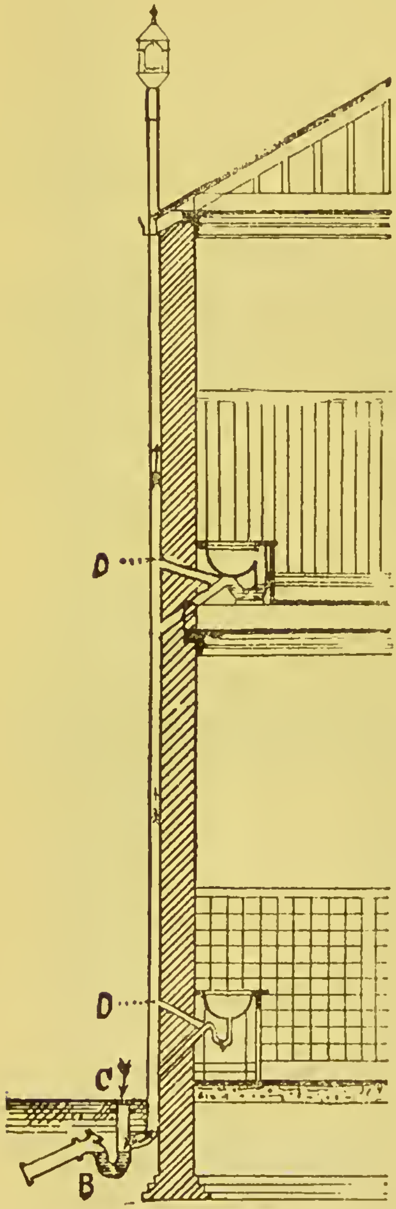

Fig. 18.

When a soil pipe is of a diameter of four inches, and is intended to receive the discharges from several water-closets, it is desirable that an inspection cover should be provided opposite each branch pipe from a closet basin entering the said soil pipe.

The upper or free extremity of the soil pipe should be fitted with a cowl to facilitate the passage of the up-current therefrom, and to prevent the rain from passing down it. Fig. 15 illustrates an improved cowl made by Messrs. J. Tylor and Sons, Limited, London, and especially designed for the top of a ventilating pipe or shaft.

When the natural current is sluggish, and there is a tendency in the gases to hang about in the drains and inspection chamber or chambers (when a second one is provided at the upper end of the soil drain), it is sometimes desirable to place a powerful exhaust cowl, or ventilator, upon the said top or free end of the soil pipe, or ventilating shaft. No better apparatus can be used for this purpose than one of Boyle's improved patent air-pump ventilators, which will be found fully described and illustrated (Fig. 115) later on in the chapter devoted to the "Ventilation of Dwelling Houses." This induced-current exhaust ventilator has been successfully employed for this purpose by sanitary specialists, and the results have been found to be eminently satisfactory. Fig. 16 is a front elevation, and Fig. 17 a vertical section, showing a double-action system of soil pipe ventilation by means of one of Boyle's patent air-pump or exhaust ventilators, and one of his downcast ventilators, and also the ventilation of the interior of the water-closet and lavatory chambers. C indicates the soil pipe, D the up-cast pipe, E the junction of above pipes over the intercepting trap G; B is the downcast ventilator, H is a separate ventilating pipe connected with the drain, F F are anti-syphonage and ventilating pipes to ventilate the waste or discharge pipes, or branches from the closet and lavatory basins, which pipes are connected to the said waste pipes and to the upcast ventilating pipe D. The inlet ventilator being situated well above the roof (as well as the exhaust ventilator) the same danger from the escape of noxious gases does not exist as when the said inlet is placed at or near the ground level, and the valves should from any cause stick or remain open, on a return-current of foul air or gas rising from the drain.

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* Unless some such arrangement as Riley's patent (see page 99) be employed, wherein a trap is interposed between the rain-water pipe or fall spout and the eaves trough.

A single-action system is shown in the vertical section, Fig. 18. In this view D is the soil pipe, which also forms the upcast or ventilating shaft, C is the fresh air inlet, B is the intercepting or disconnecting trap.

These systems cannot get out of order, as there are no moving parts to become corroded by the action of the gases and saturated air passing through the pipes.

# CHAPTER VII.

## PIPE AND OTHER JOINTS.

THE joints required to be made in order to connect together the various pipes required in the drainage, water supply, and ventilation of the dwelling-house necessitate the forming of gas- and water-tight joints between stoneware or earthenware pipes; between stoneware or earthenware and lead, or other metal pipes; between iron pipes; between lead pipes; and between lead pipes and brass or other metal.

**Stoneware or Earthenware Pipe Joints.**—These classes of joints have already been slightly alluded to when treating of soil drains. As then mentioned, a Portland cement joint, if properly made, forms a good joint for uniting lengths of stoneware or earthenware pipes; one great objection, however, is the extreme care required in laying the pipes, as any settlement will be fatal to the soundness of the joints owing to their being perfectly rigid and unyielding.

Fig. 19 shows the proper method of forming a Portland cement joint between stoneware pipes and of bedding the latter in cement concrete. When the drains do not pass beneath the house it will only be necessary, as before mentioned, to lay them on a bed of concrete, and they need not be bedded in as shown.

Another difficulty in cement joints is that the lower portions of the said joints, which should of course be the soundest and most water-tight, are, on the contrary, almost invariably the weakest and the most liable to leakage. The reason for this is not far to seek; the pipe-layer, aware that the upper portions of the joints are visible, takes what pains he can to make a neat and good job of them, but the underneath portions being more or less concealed, and requiring the spigot to be raised and carefully packed with cement, are too often scamped and defective. The difficulty in making cement joints arises from

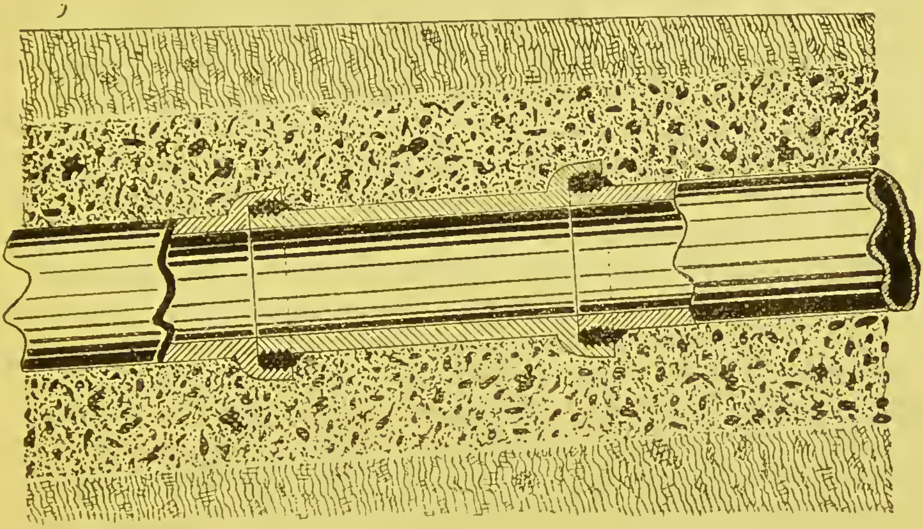


Fig. 19.

the socket being of necessity made much larger than the spigot (so as to allow room for the jointing material), and the consequent difficulty arising in centering and jointing. The dia-

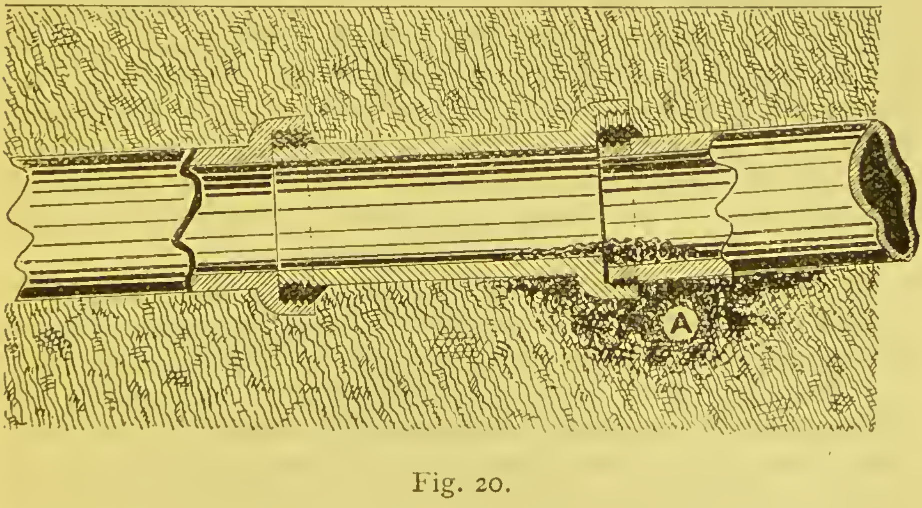


Fig. 20.

gram, Fig. 20, shows the results of a badly made joint; the spigot drops, as indicated at A, owing to the want of proper support on the underside, and the results are not only a broken and open joint admitting of the free escape of liquid sewage and sewer gas (see diagram), but also the formation of an obstructive ledge, which arrests the solids especially in cases where the gradient is slight, and causes, if not silting and complete stoppage of the drain, a considerable reduction in its capacity.

To obviate the above objection to Portland cement joints, a form of pipe has been brought out by the Albion Clay Company, Limited, known as the Paragon Pipes (patented), the principle of which is that the sockets are formed eccentric to the pipe instead of concentric, as hitherto in the ordinary pipes. The result of this is (the depth of the shoulder in the socket at the invert being only equal to the thickness of the pipe), that when the spigot is inserted and abuts at the shoulder, it rests on the socket, and having a solid bearing thereon, can not drop, as shown at A, Fig. 20, but forms and maintains a true invert at the joints, even should the pipes happen to be disturbed. The joints are formed on the undersides by cement laid in deep grooves provided in the lower parts of the sockets. The sockets, moreover, are considerably thickened and strengthened and are made flat at the base, thus giving them a firm bearing and maintaining them in true line on their bed. These patent pipes are manufactured in three forms, the first having sockets of ordinary depth, the second with deep sockets grooved and with or without grouting holes, the third with extra deep sockets grooved and with corresponding grooves in the spigots, and with or without grouting holes. The first of these classes of pipes are suitable for cases where ordinary gas- and water-tight joints are required, the second where very reliable gas- and water-tight joints are demanded, and the third where very reliable gas- and water-tight joints to stand pressure are necessary.

An advantage possessed by many of the special joints in the market is the fact of their being sufficiently yielding or flexible to remain gas- and water-tight, in spite of a slight settlement of the ground or bed. This no doubt many of them do, but unfortunately in some cases the materials of which they are composed are under strong suspicion of being liable to perish in the course of a certain period of time, otherwise they would be all that could be desired.

Some special joints take the form of screws, others are wedge joints, whilst others again are some form of ball and socket arrangement, which latter naturally admits of a very considerable displacement of the pipes taking place without (provided of course that the joint is properly made) any leakage resulting therefrom.

The "Stanford" joint, which, as previously stated, is an expired patent, is a contact joint of the wedge or compression class; care must, therefore, be exercised in driving home the spigot not to split the socket of the pipe, and also that sand grit and other foreign substances be kept out. The material for making the Stanford joint consists in one part of boiled tar, one part of clean sharp sand, and one part and a-half of sulphur, the latter ingredient being increased to one part and three-quarters in cases where it is desirable to make the joints harder for the purpose of removal. When well and newly-made, the "Stanford" forms an excellent gas- and water-tight joint, but although it will undoubtedly remain so for many years, it is not anything like so durable a material as Portland cement.

Amongst the most successful of the numerous other patent and special joints that have been placed on the market may be mentioned those of Oates and Green, Hassall, Gleave, Robbins, Archer, Tetlow, Doulton, and Sykes.

Fig. 21 shows in vertical central section the joint known as the "Nalethric" Patent Pipe Joint (Messrs. Oates and Green, Limited, Halifax). A and B are clay or cement fillets; C is the space for the cement or composition to form the joint; D is a grouting hole or aperture for pouring in the liquid cement or composition to form the joint. The arrangement of this joint is shown more clearly in the enlarged view.

Hassall's Patent Joint is made in two forms, known as the single-lined joint and the double-lined joint. These joints are of that type wherein a foreign body is cast upon the stoneware or earthenware, this being in the present case in the form of a ring or collar upon the spigot end, and a lining in the socket. In the single-lined joint this lining and collar are about half the width of the socket; in the double-lined joint two rings or collars are provided, a space being left for cement between them, and the outer ring or collar is extended beyond the socket and formed of increased diameter, so as to butt against the end of the socket. A grouting hole is formed in the socket, through which cement can be poured into the above-mentioned space between the collars. In both joints a slight clearance is left between the ring or collar and lining.

In forming the joint a thin layer of plastic cement is first smeared on the face of the lining in the socket, and the spigot end inserted and forced into its place. In the single-lined

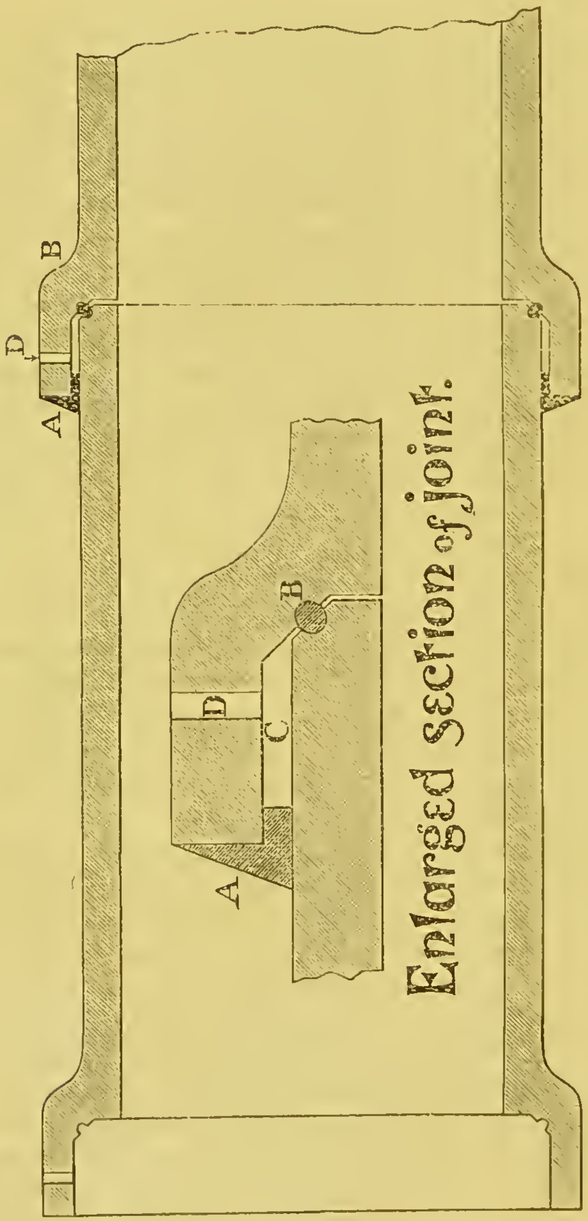


Fig. 21.

joint a dam of clay is then formed round the outside of the socket, and liquid Portland cement poured in through a way provided therein on the top of the pipe, so as to fill up the remaining space in the socket; in the double-lined joint the liquid Portland cement is poured in through the grouting hole.

Gleave's Patent Joints are also made single and double. The socket portion of the pipe is formed in two diameters internally, the smaller one being adapted to receive the spigot end with a slight clearance. The joint is formed in the larger portion of the socket. In the double joint a collar is also formed on the spigot end of the pipe, which collar is adapted to bear against the end of the socket when the pipes are in position. A grouting hole is provided in the said socket.

Robbins' Patent Joint is a double-socket joint, a second socket being formed on the spigot end, thereby forming an annular space, into which the first socket fits, the clearance being filled up with cement or other jointing material.

The Archer Patent Joint is also a double-socket joint. In this arrangement, however, a collar is formed on the socket adapted to bear against the second socket when in position. The first socket is made of reduced thickness at its

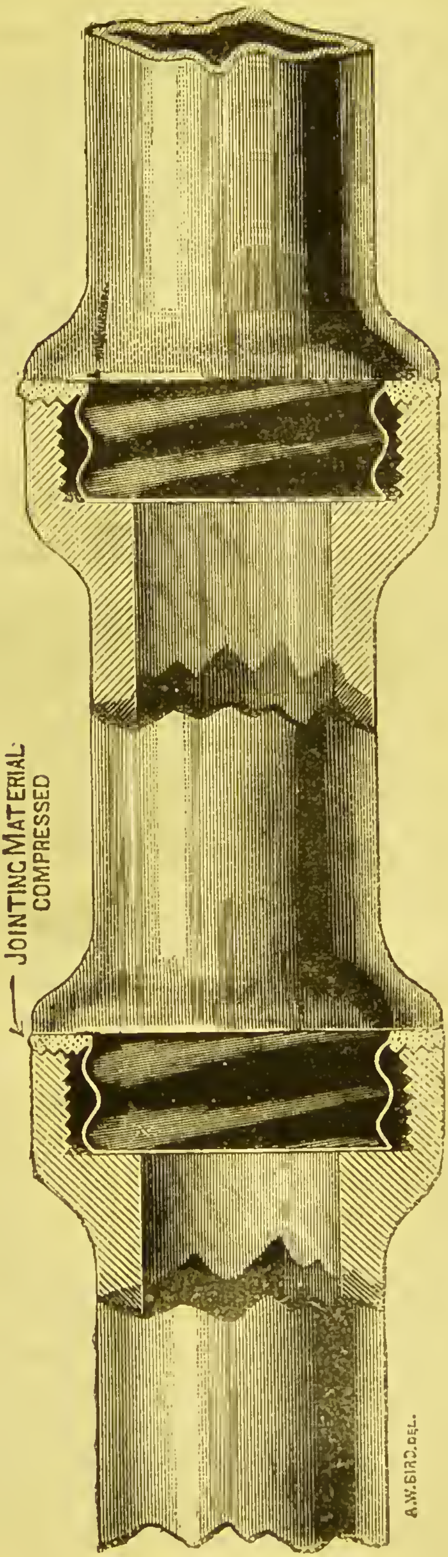


Fig. 22.

outer end, thereby leaving room for the insertion of cement to form a sound joint. Two grouting holes are provided in the outer socket, through which liquid Portland cement can be poured into the annular space to form the joint. A tamping of clay is placed between the collar on the first or inner socket and the end of the outer socket.

In Tetlow's Patent Joint the socket is formed in two diameters internally, the smaller diameter portion being adapted to receive the spigot end of the pipe, and the larger one a collar formed upon the said spigot end. Sufficient clearance is left between the spigot and collar to admit of cement for jointing being placed between them.

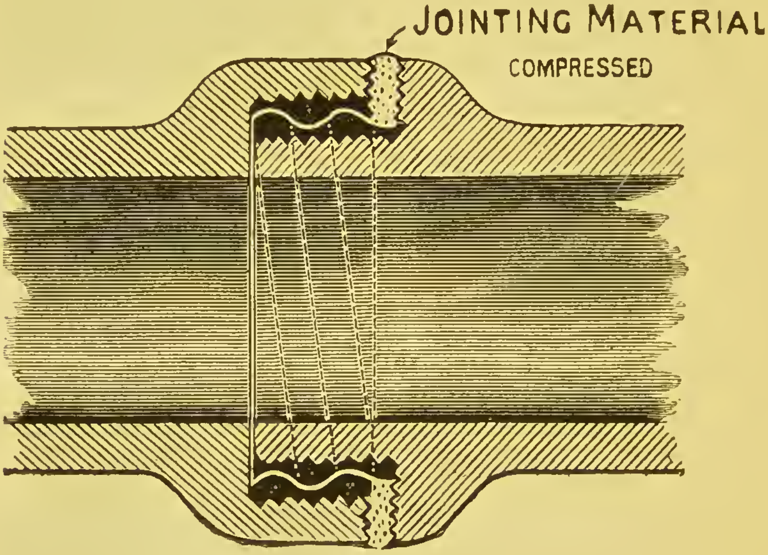


Fig. 23.

Doulton's Patent Joint is also of that class in which a foreign body is cast upon the stoneware. The socket is provided with a lining with which is adapted to engage a ring or collar half round in transverse section, thus forming a ball and socket joint which will admit of a very considerable deflection of the pipe taking place without causing the joint to leak.

Sykes's Patent Joint, Figs. 22 and 23, manufactured by the Albion Clay Company, Limited, is the invention of Mr. W. Sykes, who, as before-mentioned, was formerly connected with the Fulham Vestry. This joint received the highest award at the late Chicago Exhibition. An important feature in connection with it is the fact of its being compound, thereby affording a greater margin of safety. As will be seen from the drawing, a male thread is cast on the spigot end of the pipe, and a female thread in the socket, so as to form a screw-joint. A strong rim or collar, moreover, is formed on the pipe at the spigot end, against which a rope or fillet of cement composition is placed, which, upon screwing up the pipe, is compressed between the end of the socket and the above-mentioned collar, so as to make a sound gas- and water-tight joint. It is claimed for these joints, amongst other advantages, that they will be perfectly water-tight, even when laid in bad ground, as there is sufficient play in the threads to prevent their being affected by sand, or even gravel or small stones, when they are screwed up; and, moreover, that as the material used for jointing does not set with too great rapidity, the joints are not injured by a slight settlement of the ground, inasmuch as they will yield slightly for some time to any severe strain. These joints are highly recommended by competent authorities, and they can be laid equally as well when submerged in water as when the trench is dry.

**Joints between Earthenware and Metal.**—To form a good connection between the lead flushing or service pipes and the earthenware arms of water-closet basins, between the earthenware traps of the latter and the lead soil-pipes, and between the lead soil-pipes and the stoneware or iron soil drain-pipes, has always been a matter of some difficulty. For the first-named job the old putty joints have of late been almost entirely superseded by ones formed with india-rubber cones, and by various forms of mechanical joints. To make a putty-joint connection between a lead flush-pipe and the earthenware arm of a closet-basin, the lead pipe should be fitted for about half or three-quarters of an inch inside the said earthenware arm, an eighth of an inch or so clearance being left. The parts being thoroughly dry should then be painted with red lead, the putty (as little as possible) be placed on and moulded, a strip of fine canvas, about two feet in length by four or five inches wide, be wound round the joint, and five or six feet of strong twine be bound tightly round it; after which the joint should be trimmed and covered on the outside with a thick coating of red lead paint.

India-rubber cones are used by passing them over the earthenware arm of the basin and the lead flush-pipe, and binding them in position with string or copper wire. India-rubber cone-joints form perfectly water-tight and excellent ones, there being besides far less liability of the arms bursting off during frosty weather; but they are liable to perish, and require periodical renewal. The average life of an india-rubber cone is about six years.

Stidder's patent cast-lead closet-arm joint enables an excellent and lasting joint to be made. Suitable lugs are formed on the bend of the inlet, by means of which the latter can be drawn firmly up to the arm of the closet-basin by means of strong twine or copper wire. To facilitate the forming of the joint, rings or collars, moreover, are provided on the said bend.

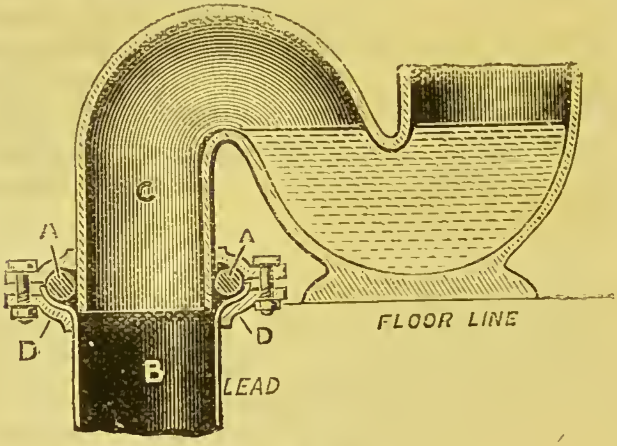


Fig. 24.

Another joint, known as the "Grip Joint" (Sharpe's Patent), consists in forming screw threads upon the earthenware closet-arm, and providing a leaden union to screw on same. This joint is also used for connecting the earthenware closet-trap to the soil-pipe.

A very effective joint for connecting the outlets of earthenware closet-traps to the lead soil-pipes, or the lead soil-pipes to the stoneware or iron soil drain-pipes, is Mr. Milton Syer's "Reliable" Joint, for which a patent was granted to him in 1893. A great advantage possessed by this joint is that it affords a certain amount of elasticity, thus admitting of some movement or play, and allowing a slight settlement of the work to take place without the earthenware trap being broken and the closet rendered useless, a result of frequent occurrence when fixed and rigid joints are used. Fig. 24 is a vertical central section showing the method of connecting the outgo of a stoneware or earthenware S trap to the lead soil-pipe by means of this patent joint, and Fig. 25 is a side elevation, partly in section, showing the joint used for connecting a lead soil-pipe to a stoneware or iron soil drain-pipe. A is an india-rubber packing-ring; D D are metal flanges which are drawn tightly together by means of bolts; B is the lead soil-pipe; and C is the earthenware or stoneware drain-pipe, or iron soil drain-pipe. Like letters indicate corresponding parts in both views.

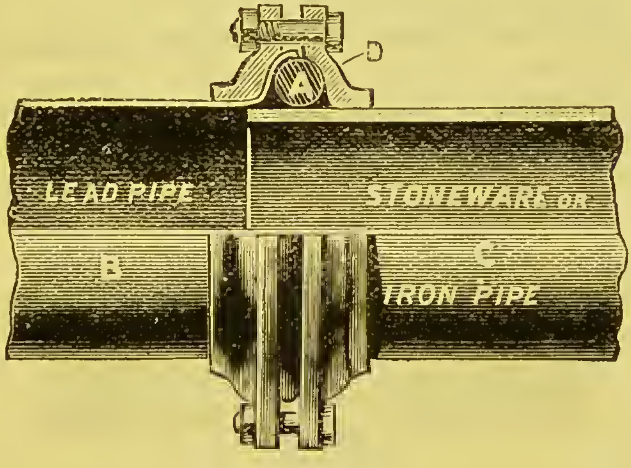


Fig. 25.

A novel method of connecting earthenware or stoneware to metal has been lately devised by Messrs. Doulton and Co., Lambeth. The joint in this case is made by painting over the part of the earthenware to be united to the metal with a metallic solution and firing, the earthenware having been previously glazed in the usual way. A thin metal film is formed in this manner on the surface of the stoneware, and to this lead or other metal can be firmly soldered, and will unite perfectly therewith so that it cannot be removed without tearing the surface of the earthenware. Joints made in this manner are said to have withstood a test of 250 lbs. on the square inch. This invention is obviously valuable for forming strong gas- and water-tight joints between earthenware or stoneware and metal, and is especially applicable to the joint between the earthenware arm of a closet basin and the lead down, service, or flushing pipe.

**Joints of Iron Pipes.**—Iron soil-pipes and soil drain-pipes are of the socket and spigot class, and the joints should be run with blue lead and well caulked; or rust joints formed with a cement consisting of sal-ammoniac one part, flour of sulphur two parts, and iron borings eighty parts, may be employed.

**Joints of Lead Pipes.**—These should be soldered and of the class known as wiped or plumbers' joints; blown or copper-bit joints are seldom admissible. The same class of joints must be employed for uniting lead pipes to brass unions.

A patented metal union or coupling for connecting together lead pipes or other ductile metal pipes is manufactured by Messrs. J. Tylor and Sons, Limited, London, by means of which a perfectly sound, solid, unbreakable, imperishable joint can be made, wet, single-handed, without skilled labour, and without the use of a fire. This device, which is shown in Fig. 26, consists essentially in a suitable grooved sleeve, thimble, or intermediate piece, over the extremities of which the ends of the lead pipes to be joined or united, previously spread by means of a turn-pin or tan-pin, are passed, and upon which they are clamped firmly in position by means of nuts or unions, which must be first placed in position upon the lead pipes. Not only can an excellent and very strong joint be made by means of this coupling, but also one which is capable of being disconnected at will, and which, moreover, enables a sound job to be made in positions where it would be impossible or extremely difficult to make a wiped or plumbers' joint.

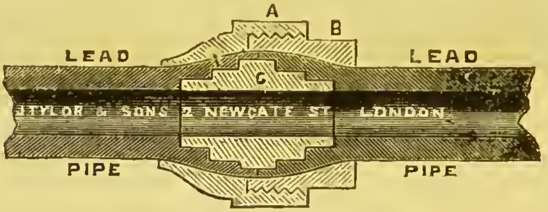


Fig. 26.

To make a good sound and neat wiped joint is not so easy a matter as is generally supposed, and requires a considerable amount of practice, especially in the case of pipes of large dimensions. A wiped joint is made without the use of a soldering iron. A coating of a mixture of size and lampblack is first put on to prevent the adherence of solder where not wanted; the parts to be united are scraped with the shave-hook, and smeared with tallow. The solder, which must be heated in a plumbers' pot to a somewhat higher temperature than the melting point, is poured on the joint, being supported by a cloth folded several times and saturated with grease to prevent its burning, and by means of which it is then smoothed and moulded, or wiped into shape, and the surplus solder removed.

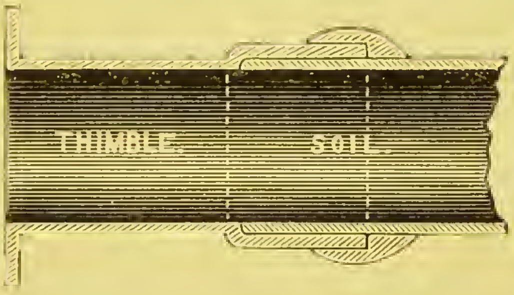


Fig. 27.

What are technically known as striped joints are formed by the use of both soldering iron and cloth, but are far from being as neat in appearance as the wiped joints.

Fig. 27 illustrates a handy joint, lately patented by Mr. J. Jones, for facilitating the connection of lead pipes to brass sleeves or thimbles, the use of which enables a much firmer joint to be made with much greater facility. The bore of the pipe, moreover, is uniform, and no shoulder or obstruction exists. As will be seen, the sleeve or thimble is cast with a socket to receive the lead soil-pipe.

# CHAPTER VIII.

## TESTING HOUSE-DRAINS.

THERE are three methods in use at the present time for testing the drains of dwelling-houses with the object of detecting leakages therein, viz., the hydraulic or water test, the smoke test, and the test by the sense of smell, or the odour test. The two latter are frequently combined.

The first of these, or the hydraulic or water test, is the one most to be relied upon for the discovery of leakages in the joints of a soil-drain situated below the level of the ground. The test by means of smoke, and by the use of chemicals or drugs possessing strong and pungent odours, is more advantageously applicable for the testing of the soil-pipes, branches, joints, traps, and other fittings which are situated above ground. The hydraulic or water test should always be insisted upon when newly laid or suspected soil-drains are in question, and it should never be taken as a sufficient evidence of the soundness of the said drains that a satisfactory test was carried out (hydraulic or otherwise) before the said drains were covered in and the building completed.

With respect to the necessity of having perfectly water-tight soil-drains, and to the making of a second test after the said soil-drains have been covered in, the following, taken from a report lately made by Mr. T. de Courcy Meade, M.I.C.E., Engineer and Surveyor to the Hornsey Local Board, may be quoted. In the course of this report Mr. Meade says:—

"As to the suggestion to abandon the hydraulic test of the drains on the completion of a building, I would remark that with ordinary care there is no reason why all drains should not be laid in such a manner as to be perfectly water-tight, not only at the time they are laid, but also after they have been covered in and the building completed. Drains properly constructed will remain in a perfectly water-tight condition. I have had opportunities of testing the drains of houses which had been laid many years previously, and I found them perfectly water-tight. It is of little use to test sections of a drain before it is covered in, and to omit the final test of the finished drain on the completion of the building. The weak points are generally found in the branch drains, which, in practice, cannot easily be completed until the building is well advanced; and it frequently happens that carelessness in filling and ramming the trench over the drain is a cause of subsequent failure.

"Drainage work used formerly to be sub-let to a labourer, and this custom still prevails in some cases, although it cannot be expected that drains laid by piece-work should continue water-tight. . . . I have seen leaky drains taken out of old buildings where concrete had been used, and it was only necessary to observe the filthy condition of the concrete and the ground adjoining to have forcibly impressed upon the mind the necessity of laying all drains with perfectly water-tight joints. . . . Clay, contrary to what is sometimes thought, is one of the most treacherous materials with which a drain trench can be filled. It is difficult to thoroughly consolidate the clay without risk of damaging the drain, and, even where the greatest care is used, cracks will almost invariably appear in the clay filling, as it becomes dry and shrinks, where protected from moisture by the dwelling-house. These cracks afford a free escape for the gases from a defective drain into the building, and even the concrete with which the surface of the building is covered is not proof against their egress."

The almost universal consensus of opinion of the numerous borough engineers and surveyors, as given in the above report, is in favour of the use of intercepting traps, and as to the necessity of absolutely water-tight drains.

The hydraulic or water test, as already mentioned, is the only reliable one in use for testing underground drains, but in the opinion of the writer even this test is not as usually applied sufficiently drastic, it being possible that bad leaks may be temporarily stopped or plugged with dirt so as to prevent the water, which is under but little or no pressure, from passing during the test, but affording ample scope for future mischief. Drains should be tested under a sufficient pressure (which may be secured by providing a suitable head of water in the soil-pipe or pipes) to search and find out any weak points in the joints.

Where get-at-able, an easy method of readily detecting and locating a suspected open or leaky joint in a soil-pipe or soil-drain, is said to be by taking a piece of white muslin, soaked in a solution of acetate of lead, and laying it over the said joint. If a leak exists, the gas escaping through the apertures will pass through the meshes of the muslin, and it will be blackened by the sulphur compound.

**The Hydraulic or Water Test.**—This test, as now usually carried out, is extremely simple and easily performed. The lower end of the drain to be tested, having been first stopped or dammed up by means of a suitable stopper, in such a manner as to be perfectly water-tight, and to admit of no possible leakage past the said stopper, the said drain is filled with water, and is allowed to stand for some time. If after a sufficient period has elapsed the level of the water is found to be gradually lowering, the drain is leaking somewhere.

When carrying out the hydraulic test it is advisable to take especial precautions to avoid the test being nullified by any tricks or tampering by interested persons. It is not an uncommon occurrence for the wily builder to station a confederate, in the person of a friendly plumber, in an upstairs water-closet (on pretence of executing some repairs), with instructions to gently dribble down a sufficient quantity of water to make up for that which he confidently expects will leak from the drain. In this manner the sanitary engineer or other person performing the test may be completely deceived, and induced to pass as water-tight a drain which in reality leaks like a sieve. In some instances, owing to the drain not being so leaky as it was supposed to be, or from the friendly plumber in his over-anxiety to ensure the success of the ruse overdoing the thing, the person watching the test has been astonished to find the level of the water actually rising. The moral of this is that a thorough visit of exploration should be made before starting the test, and all stray workmen be cleared out, or a sharp look-out kept upon them.

Several handy arrangements have been devised for stopping up and making water-tight the ends of house-drains when it is desired to carry out the water test. Fig. 28 illustrates a Patent Expanding Screw Stopper, with an indicator attached, which is the invention of Mr. J. Jones.

This stopper consists of two plates or discs of galvanised iron, having grooves, between which a special hollow rubber-ring is placed. A screw is also provided and a key, by means of which the said plates can be moved towards each other, thereby causing the rubber-ring to expand outwardly to the extent of about one inch. This will be found sufficient to effectually plug or stop any pipe, provided the proper size of stopper for that pipe be used.

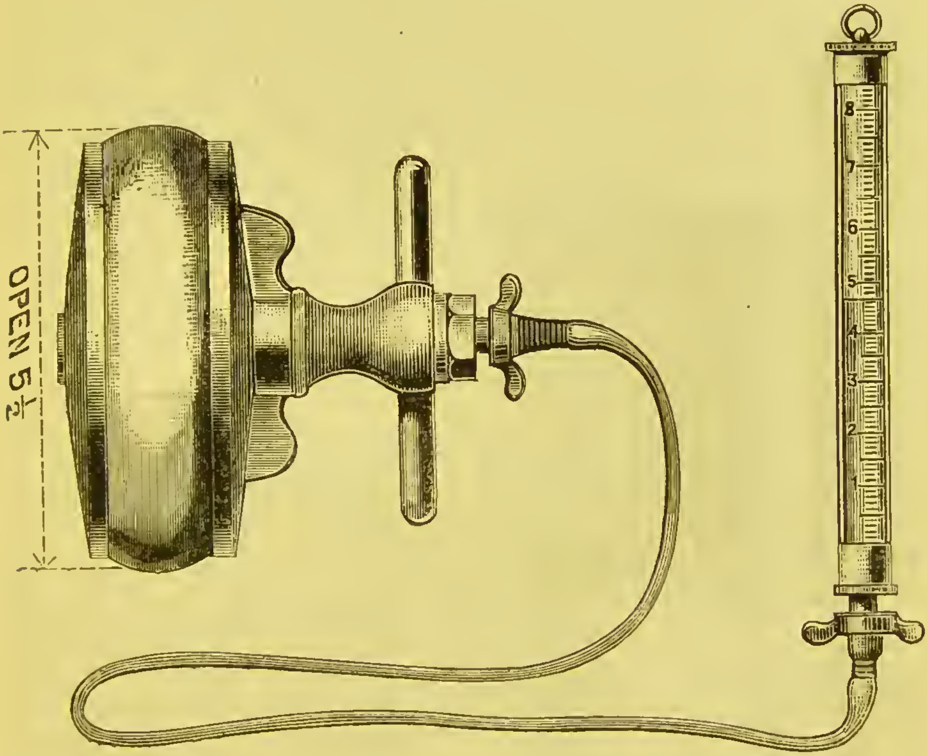


Fig. 28.

The above screw-stopper is sometimes provided with a central outlet, to which an indicator may be attached, as shown in the drawing. By means of this indicator the fall of a drain can be accurately gauged, and the slightest leakage can also be readily detected.

Another very useful form, which is the invention of the same gentleman, is the Pneumatic Pipe-stopper, illustrated in Fig. 29. It consists of a cylindrical-shaped bag formed of india-rubber or other elastic and waterproof material. To this bag is attached some six feet of flexible tubing with a tap at the end, and a union for permitting of its being connected to a small force-pump, such as is usually employed for inflating footballs or pneumatic cycle tyres. In using the apparatus the bag should be placed in the drain before inflation, and quickly filled with air by working the pump, a sufficient pressure being got up to dam the drain and prevent any escape of water. The tap should then be closed, and the inflated bag remains in that state as long as required. When done with, the tap is opened and the air released. when the bag can be withdrawn. The bag is shown in the drawing in position in the drain-pipe, the latter being in vertical section, and inflated or expanded so as to bear against the internal walls, and to completely close same, and form a perfectly water-tight dam or stopper. Amongst the advantages claimed for this invention may be named lightness and flexibility, enabling it to be folded and carried in a small compass; also that it can be placed in syphons, gullys, and other traps, where all other stoppers frequently fail to act.

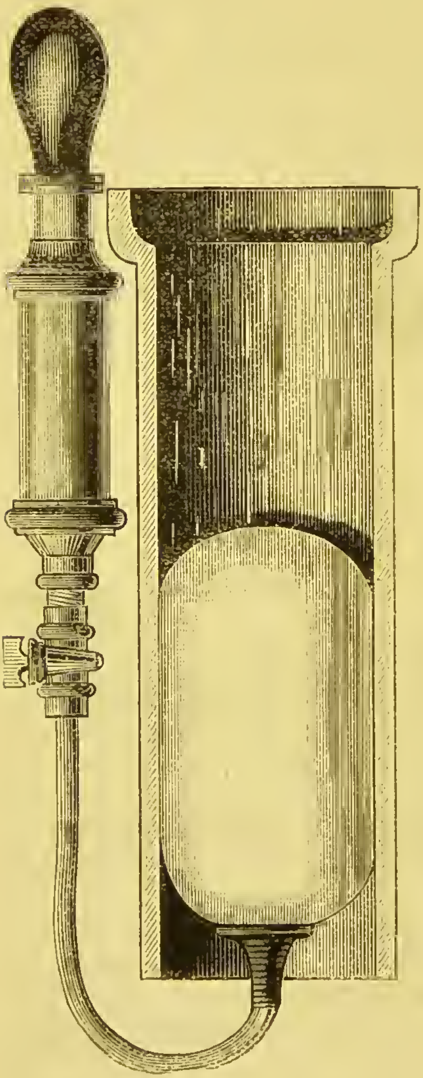


Fig. 29

**The Smoke Test.**—This is a useful test for detecting leaks in traps, soil-pipes, branches, and other above-ground and internal fittings, or for testing a length of drain before it is covered in. It is performed by filling the drain to be tested with smoke, and noting whether or not there is any escape of the said smoke into the house. As the smoke is usually also of an extremely pungent odour, it really also combines an odour test.

The smoke test may be divided into two classes, the negative and the positive; the latter, which is the most effective test, being performed by forcing the smoke (generated on the exterior) into the drain to be tested. The first is usually performed by means of some simple apparatus for generating smoke in the interior of the drain, such as smoke rockets, so arranged that they can be inserted into the drain to be tested by means of a rod or wire, and forced through and past the intercepting trap. All ventilators and other openings from the drain must be carefully stopped or plugged. These rockets are filled with chemicals, are inextinguishable, and give off a very powerful and pungent volume of smoke.

A handy little drain-tester has been lately brought out (Kemp's Patent), which is convenient on account of the extreme ease with which it can be applied by any occupier or intended occupier of a dwelling-house without extraneous assistance, and without making any bother or mess about the place; it is also inexpensive. It consists simply in a thin glass receptacle or tube, filled with a chemical having a powerful odour and burning on water, thus being also a smoke producer. This receptacle or tube is supported in a suitable socket, and is so arranged in connection with a spiral spring, that upon the release of the latter it will be broken and the contents permitted to escape. This spring is normally retained in position by bands or strips of paper. In using this tester all that is required is to secure to a ring or loop provided on the upper extremity of the cap or socket, one end of a piece of string, of sufficient length to admit of the tester passing into the drain, then, having firmly secured the other end of the said string, lower the tester gently into the basin of a water-closet, or into a gully-trap, and immediately pour down a bucketful of hot water, which will wash it past the trap into the drain. In about a minute the paper bands or strips, being softened by the hot water, will give way and release the spring, by which the glass tube or receptacle will be fractured and the contents discharged into the drain. The test should be maintained for about fifteen minutes, after which the socket or cap and spring may be drawn back by means of the string, and the discharge of the contents of the tube into the drain verified, so as to afford proof of the proper working of the apparatus and the soundness of the test.

Fig. 30 illustrates Messrs. Burn Brothers' (London) Patent "Eclipse" Drain-Tester for applying a positive smoke-test to drains. This apparatus consists of a double-action bellows, covered with specially prepared leather, and a copper cylinder or vessel with an outer casing, which latter is filled with water. In this casing a cover or float is placed, which rises and falls with the action of the bellows. The hose must be connected to the drain or pipe to be tested, and all openings, such as ventilating pipes, plugged. A few strokes of the bellows will raise the float, and if it remains stationary the drain will prove tight. If the float falls a leak exists, and may be traced by using the smoke-test.

A great advantage in using this machine is that the operator can ascertain whether the drain is tight or not without leaving the apparatus.

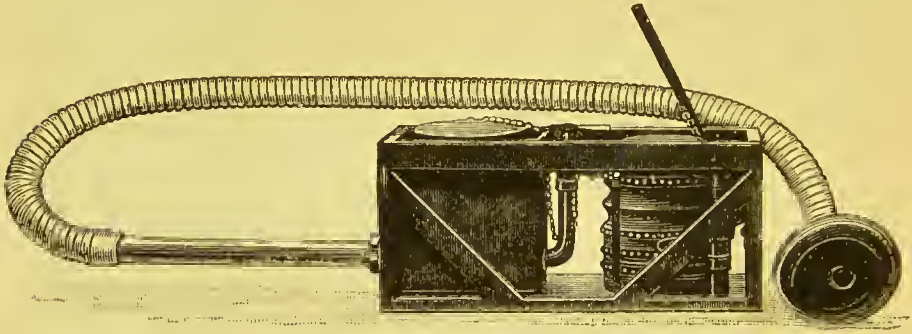
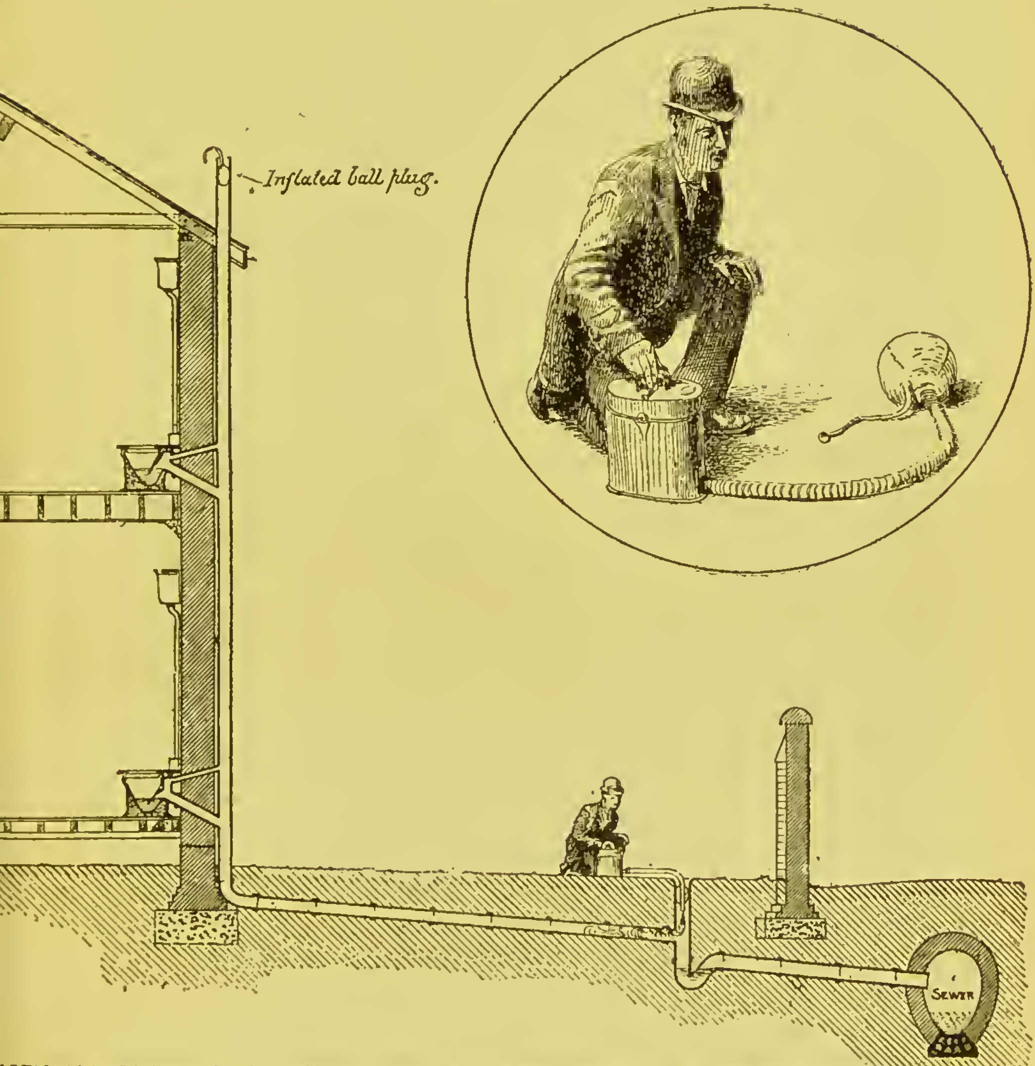


Fig. 30.

Fig. 31 shows another patent apparatus for applying the smoke-test to drains, which is the invention of Mr. J. G. Kirtley, of Sunderland. The apparatus, which is known as the "Eureka," is simple in construction, consisting in a double-cased cylinder, the intermediate space being charged with water. In this position the piston works with the utmost freedom, having proper valves for the admission of the supply of the air necessary to the burning material, which, after being lighted, is placed on the perforated platform of the inner cylinder. The least movement of the piston by hand causes a steady stream of smoke to issue through the nozzle. Attached to this nozzle is a length of specially-prepared flexible tube, and to this an expanding plug. This plug is constructed so that it can be made in a moment to form a perfectly tight joint in any pipe or trap, ranging in size from three inches up to ten inches, the smoke passing through it.



CTIONAL DRAWING SHOWING THE TEST BEING APPLIED TO HOUSE DRAINS

Fig. 31.

The drawing shows the apparatus ready for use, and also the method of applying the test to house-drains.

**The Odour Test.**—The odour test, pure and simple, is performed by passing into the drain beyond a trap (all ventilators and other apertures having been first plugged or stopped) some drug or chemical having a powerful and pungent odour. Should this odour, which must be one easily identified, be perceived in the dwelling-house, the assumption is that the drains or fittings are leaking somewhere. Peppermint is the drug most usually employed for the purpose, as having an extremely powerful and tenacious, and also an easily recognised odour.

The difficulty in applying this test is that when handling the peppermint the operator not unfrequently spills some of it about, and consequently gets the smell into his nose, and is thereby rendered very liable to be deceived. To obviate this objection, a simple apparatus has been devised (Kemp's Patent) for the insertion of the peppermint into the drain without the possibility of any being spilt about, and the consequent mistakes being made. The device consists in a metal casing, having a cylindrical recess adapted to hold a small hermetically-sealed glass bottle or tube, containing a charge of the drug, and the aperture to which recess can be tightly closed by means of a screw plug, so as to prevent any possible leak. In connection with this recess is arranged a plunger, which can be operated by turning a handle, so as to enter the said recess and break the bottle. The recess, moreover, is connected at one side with a flexible india-rubber pipe, preferably of that type known as armoured hose, which pipe has, at its free end, a small frame or carriage, fitted with a couple of rollers, and is of a sufficient length to admit of the said carriage being conveniently passed through an intercepting trap into the drain; and is connected at the other side through a U-shaped metal pipe, with a short length of india-rubber pipe, having at its free end a funnel of the same material. This latter pipe forms, when filled with water, an intercepting trap. In using the apparatus the bottle of peppermint or other drug is inserted into the recess, the aperture tightly closed, and the trap at the other end is charged so as to prevent any escape of the odour back into the house. The long or armoured pipe is then passed through a gully-trap or otherwise into the drain to be tested, and the plunger operated to break the bottle, the contents of which escape, and, on pouring some hot water through the funnel and pipe at the other end, are carried through the long flexible pipe and washed down the drain.

# CHAPTER IX.

## WATER-CLOSETS.

THE water-closet, as an invention, dates back to the time of the Romans. That constructed in the palace of the Cæsars was ornamented with marble arabesques and mosaics, and was fitted at the back with a cistern, having faucets for the different seats. Near the theatre of Pompeii the basin and pipe of a Roman water-closet, it is said, are yet to be seen. Water-closets were first introduced into England in the reign of Queen Elizabeth by Sir John Harrington.

In earlier times various descriptions of commodes or portable close-stools were in use in this country, which were usually located in the garrets or other out-of-the-way portions of the dwelling-houses.

The introduction, however, of water-closets, having some of the more essential features of those of modern date, that is to say, a basin or pan, a discharging valve, and a flushing device adapted to operate on the opening of the said discharge-valve, were not introduced until about the beginning of the present century, and were the invention of Bramah.

Water-closets are by some eminent makers divided simply into two classes: independent water-closets (that is, where each water-closet is separate and distinct, with its own branch or waste pipe connection between the basin and vertical soil-pipe, and fittings), and combined closets, or latrines (that is, water-closets so arranged that a number of basins discharge into, or apertures communicate with, one common horizontal trough or receiver, which is connected to the soil-pipe). These two classes they again subdivide into valve-closets and hopper-closets, the latter comprising all water-closets not having any working parts or mechanism. If, however, hopper-closets derive their name from the basins being hopper-shaped, or from their performing the functions of hoppers, then valve-closets, the basins of which are usually every whit as near in resemblance, and whose duty is identical, should be classed as a variety of hopper-closet, and we should thus revert to the two classes, viz., independent and combined.

So numerous have the various patterns of water-closet become, however, that the writer conceives it to be advisable, for the sake of clearness of description, to divide them into a much larger number of classes, leaving the old-fashioned funnel-shaped hopper-closet pans or basins (to which the name was originally no doubt given on account of their striking resemblance in form to hoppers), long, short, and wide, with or without flushing rims or arms, to stand by themselves as representatives of that class.

With this object in view water-closets have been divided into eight principal classes, viz., the hopper-closet, the pan-closet, the valve-closet, the wash or flush-out closet, the wash or flush-down closet, the syphonic closet, the trough-closet or latrine, and the slop or waste closet.

A water-closet should, if practicable, be placed in a wing, and be as much as possible separated and cut off from the main portions of the dwelling-house by forming the approach thereto through a corridor or passage, having abundant means of cross ventilation. If this arrangement be unattainable, a water-closet should be situated against an outer wall, and have a window opening to the external air, and carried up to as near the ceiling as possible. Ventilators under the control of the user of the closet should also be provided, so as to ensure a current of fresh air passing through the place, and thus preventing the possible lodgment of any foul and noxious gases therein. Water for flushing water-closets should not be supplied from a cistern having a draw-off tap for domestic use, but should have a separate cistern. Where this is impracticable on the score of expense or otherwise, they may be cut off by the use of water-waste preventing cisterns, some types ot which will be found described later on under that head.

Slops from the bed-chambers should never be thrown down a water-closet of the ordinary construction. Specially arranged basins are provided adapted for use either as a closet or as a slop-sink. It is far preferable, however, in large houses, to provide a properly constructed slop-sink placed against an external wall contiguous to the bed-chambers. An easy plan is to carry the pipe from this sink out through the wall, and to arrange it to discharge at the foot into a gully-trap, the said pipe being provided with a copper flap-valve on its lower extremity, but no trap being provided under the slop-sink. Should, however, the waste from the sink discharge directly into the soil-pipe, it must be properly trapped, and due precautions taken to prevent the water in the said trap from being syphoned or sucked out when the said soil-pipe is being flushed. A proper supply of water for flushing purposes should be laid on to the slop-sink.

The soil-pipe from a water-closet should be, as before stated, of lead or iron, and the joints should be perfectly tight. It should be situated externally to the house, and should, when possible, be carried up, in its full diameter, to a height of two or three feet above the roof for ventilating purposes, and so as to be well clear of all windows.

Types of the different classes of closets above mentioned are described and illustrated *seriatim* later on in this chapter, and the various advantages and disadvantages connected with each of them are set forth. In the choice of a water-closet, the peculiar circumstances of each particular case must naturally play an important part, but where no specific objections are in the way, the best and simplest form, in the opinion of the writer, is the wash or flush-down closet, in which there is no metal work to corrode, or working parts to get out of order. It must, however, be borne in mind that no closet will remain long in order, or in a sanitary condition, unless due and proper attention be paid to it.

Especial care must be taken to choose a basin and S or P trap designed on thoroughly sanitary principles. Those constructed on the pedestal system, with the basin and trap formed in one piece, are to be preferred. The basin should be of such a shape as to avoid as much as possible fouling, and the flush should be so spread or directed as to cleanse every portion thereof, a rim flush where properly arranged being preferable to that formed by a spreader. To avoid fouling the sweep of the basin should be easy and steeper at the rear. The surface of water normally resting in the basin should be as large as possible. The bore of the trap should be uniform throughout. The sweep of the trap should be easy, and so designed as to admit of the whole trap being thoroughly flushed with a minimum quantity of water, and the said trap should not have any corners wherein a deposit of soil might possibly take place.

It should be particularly borne in mind that it is necessary, to ensure complete safety, to have the trap fitted with an anti-syphonage or ventilating pipe, otherwise a risk will be run of the said trap being syphoned out by the passage of water or slops down the soil-pipe. An anti-syphonage pipe consists in a pipe communicating with the upper part of the trap and the atmosphere. The seat, as also the flap of the closet, should be hung on hinges, and there should be no boxing or casing surrounding it, but it should be open so as to admit of a perfectly free ventilation of the space around the apparatus, and of its being kept well cleaned out. The height of the seat from the floor level should not exceed one foot four inches.

**Test for Cleansing Capacity of a Water-Closet.**—A handy method of ascertaining approximately whether the shape of a basin is favourable to its being efficiently cleansed by the flush, and also the relative cleansing power of different flushes and water-waste preventers, is to paint the interior of the said basin or pan with a mixture of lampblack size and water. This mixture must be of such a consistency as to admit of the basin being evenly covered with it, and must neither run off nor dry too rapidly. Whether or not the basin is constructed upon proper lines for cleansing, can be readily ascertained by admitting the usual flush, and noting the surface thereof that is cleared of the composition. The value of flushes of different amounts and of varying velocities can be also easily estimated in this manner.

The above is a very usual method of testing the comparative merits of variously shaped basins, and the cleansing capacity of a given flush under favourable conditions ; but it would be obviously impossible and absurd to imagine that by a few such trials the future behaviour of a closet that will be subjected to severe and constant use, and most likely liable to receive all manner of unfair treatment, can be gauged.

Moreover, it has been found in practice that some closets giving particularly favourable results in the cleansing of the basin when tested in the above manner, are not good clearing basins, paper or other matter being carried round and round in a sort of vortex or whirlpool formed by the flush in the said basins, and remaining behind at the termination of the said flush. This is a serious drawback, as after the closet has been used several times in succession, an accumulation is likely to take place, and the trap to become choked, unless the closet be flushed several times in succession without being used.

**The Hopper Closet.**—Hopper closets may be subdivided into three classes—the long hopper, the short hopper, and the wide hopper. They consist of conical-shaped basins (Fig. 32), and are identical in form, the difference between the first two being only in length, and in the case of the latter in the size of the aperture or apex of the basin. Hopper basins are usually fitted to an S or P trap, and are sometimes designed to be used with a flushing arrangement of some description and sometimes not. In the latter case the contents of the basin are washed into the soil-pipe by pouring in slops or water by hand.

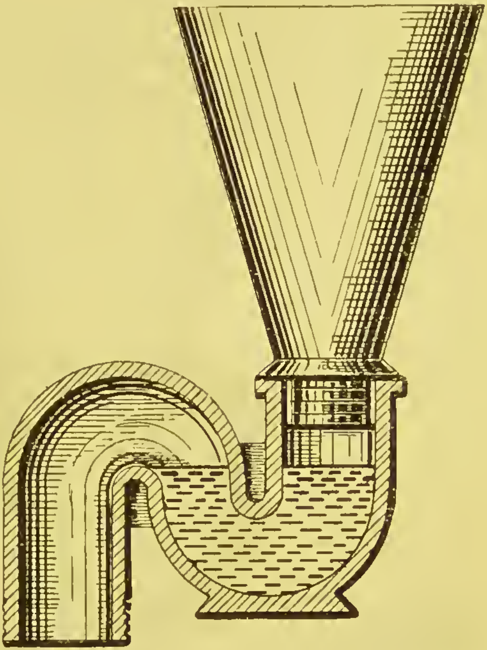


Fig. 32.

Hopper basins are in shape peculiarly suited for becoming foul, and are in every way objectionable. They should under no circumstances be either put in, or, where found already fixed, be retained in use.

**The Pan Closet.**—The pan-closet is a type of closet once extensively employed, and still frequently to be met with in the older class of houses. The pan-closet is in reality a species of valve-closet, the pan and water contained therein acting as a sort of valve and forming a water seal or trap in addition to that in the trap beneath. As, however, pan-closets do not possess a valve adapted to bear against a seating and form a tight joint that will stand pressure, it is better to distinguish them as a class by themselves, and not to confound them with the valve-closets proper. Pan-closets have been made in great varieties, the differences, however, being entirely in details of construction, and the main characteristics remaining always practically the same. These characteristics are shown in the diagram, Fig. 33. They consist essentially in a basin fitted with a pan, a container, and a D, or helmet trap. The lead safe or tray shown is usually omitted in the commoner types of this closet.

The great objection to the use of the pan-closet is this container (see Fig. 33), which is situated directly beneath the basin, and which must necessarily be of large dimensions to admit of the requisite movement of the pan to and from the lower end of the basin. This container is a constant source of danger, and altogether an abomination. The trap which is placed below the container is also most objectionable, being a leaden trap of either the type known as a "helmet" or a "D" trap, both of which are of a form and construction highly favourable to the retention and accumulation of deposit. D and helmet traps have been removed from old houses where they had been in use for a number of years, and were found to be nearly completely choked up with foul deposit.

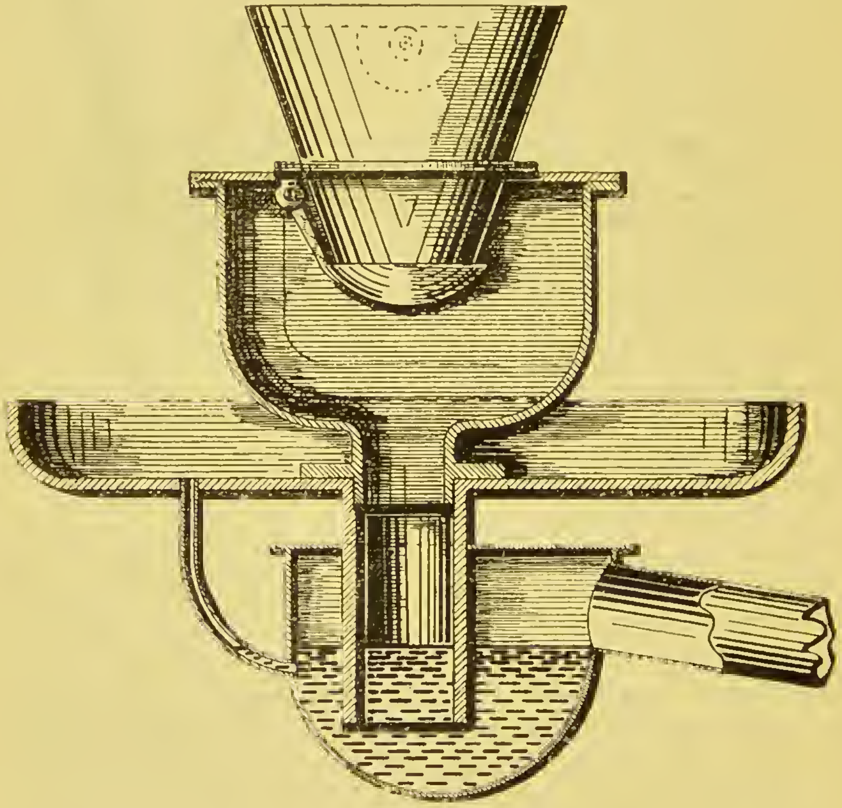


Fig. 33.

**The Valve Closet.**—The valve-closet proper—that is to say, a closet wherein a valve adapted to bear against a seating and form a tight joint is provided at the outgo from the basin —is, according to some authorities, the best form of water-closet. One great advantage undoubtedly possessed by valve-closets is that they have a double trap or seal, inasmuch as, in addition to the hydraulic or water seal in the ordinary S or P trap, there is a close-fitting tight valve covered with water, a double safeguard being thus provided against the egress of sewer gas from the drains. Moreover, the amount of water retained in the basin by the valve is considerable (usually about one gallon), and when upon opening the said valve this body of water is suddenly liberated, and in a bottom outlet valve-closet drops directly into the trap, it carries everything before it, and the usual flush following into the basin, the latter and the trap are effectively cleansed and cleared. The bottom outlet valve-closets are much superior to those with side outlet valves.

The chief drawbacks to the use of valve-closets are that they are expensive; that, having more or less mechanism and moving parts formed of metal, they are naturally liable to deterioration from corrosion and wear and to get out of order, thus entailing more frequent repairs; and that, when carelessly used pieces of paper—which, when thick and large, have an especial tendency to cling or stick to the sides of the basins—are liable to get between the valves and their seatings, thus preventing the latter from completely closing and forming water-tight joints, and permitting the after-flush water to escape and the basins to remain dry, when, if the closets be used in that condition, fouling of the said basins takes place.

It may be taken, however, that where expense is only a matter of secondary consideration, and the closets are certain to receive the attention whenever required of persons competent to maintain the working parts in proper order, no better or safer form of water-closet can be adopted than the valve-closet with bottom outlet. It should have a rim-flushed basin, the simplest possible mechanism, and a valve-box of the smallest possible dimensions.

Pedestal valve-closets are now made requiring no wood-work casing, and fitted with a hinged flap-seat.

All valve-closets must be provided with a proper overflow, which should be high up and of ample dimensions, and not a few small holes just above the normal water-line, and communicating through a pipe with the valve-box.

A substantial leaden safe or tray, 8 lbs. to the foot, having a 1½-inch waste-pipe carried through the outer wall, and fitted at its outer or free extremity with a brass flap-valve, should be placed beneath the closet.

A puff-pipe, about one inch in diameter, should be taken from the valve-box through the outer wall, and its free end be also fitted with a brass flap-valve. This pipe relieves the air from the valve-box when the closet is operated.

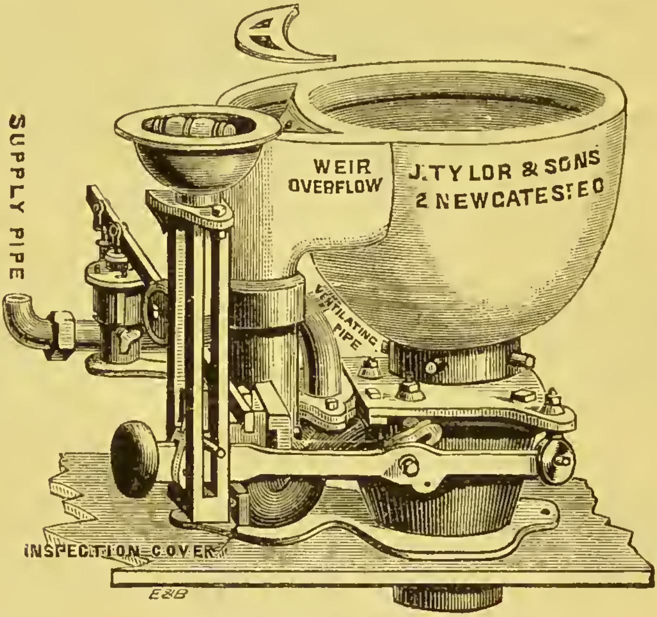


Fig. 34.

The outlet or branch pipe from the trap should be of lead, and should be joined to the soil-pipe (when a leaden one is employed) by means of a wiped joint.

When several closets are arranged to discharge into the same soil-pipe, a ventilating or anti-syphonage pipe should be carried from the top of each trap, and into the said soil-pipe, at a point above the level of the uppermost closet.

Figs. 34, 36, and 37 illustrate various patterns of valve-closets made by Messrs. J. Tylor and Sons, Limited, London. Those shown in Figs. 34 and 37 require traps under floor-level; that shown in Fig. 36 is fitted with a trap above the floor-level. The latter class of closet is useful for taking the place of an old pan-closet, where the existing soil-pipe branch comes straight up to the floor-line, and thus avoiding the trouble and expense otherwise entailed in altering the said branch. In the case of valve-closets with the trap arranged above the floor-line, especial care must be taken to see that sufficient space is provided below the valve to allow the contents of the basin to pass away clear of the said valve. This requisite depth below the valve being sometimes sacrificed, and the joint between the trap outlet and the soil-pipe branch being a very difficult one to make.

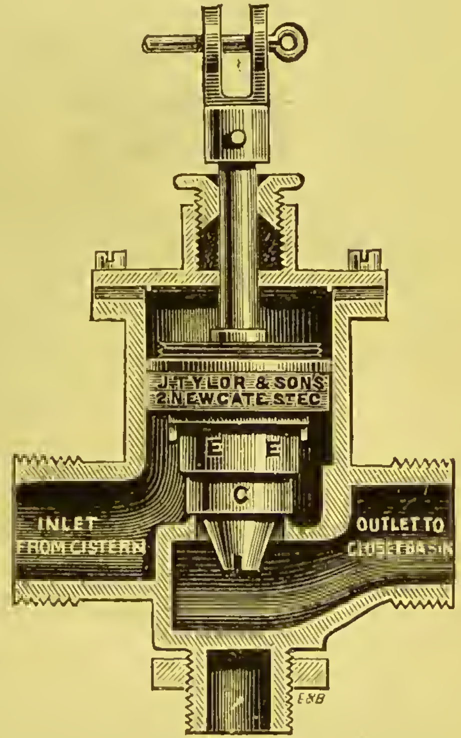


Fig. 35.

The valve-closet, illustrated in Fig. 34, has a white china or earthenware basin of semi-spherical form, having a trapped weir overflow fitted with a removable cleaning cover, and so arranged as to be effectively flushed at each action of the closet, thereby avoiding fouling. The pull-up is of a parallel action pattern, thereby rendering it easier to operate, and avoiding the unsightly appearance of a pull-up not fitted with a parallel motion, and which consequently moves through an arc of a circle when operated.

This improved parallel motion device consists in a slide or motion block moving in a slot or groove in suitable guide-bars, and connected or coupled to the valve-operating lever by a forked link or connecting piece. The pull-up thus moves in a vertical direction, with comparatively little friction, instead of obliquely or through an angle.

For regulating the supply of water from the service pipe, a special patented apparatus is provided, shown more clearly in the enlarged sectional view, Fig. 35. A proper after-flush is provided for trapping. The use of this regulator enables any number of closets, no matter in what part of the building they may be placed, to be supplied from one down-pipe, thereby admitting of all intermediate cisterns, service boxes, cranks, and wires, &c., being dispensed with. The apparatus is worked by a pull-up handle in precisely the same manner as is usual in other valve-closets. If the handle be propped or tied up, the valve which is fitted on a plunger or follower, free to move through a suitable distance in a socket or carrier formed on the valve-spindle or stem (and is held up in the said socket and kept off its seating during the initial movement of the valve-stem or spindle by capillary attraction, adhesion, or suction), falls partly by gravity and partly by the pressure of the water, and, closing on the seating, instantly stops the flow of water. This action takes place after a few gallons of water have passed. When the pull-up handle is lowered, the valve-plunger or follower resumes its normal position in the socket or carrier on the valve-stem or spindle, and is ready for the next operation. A bye-pass, fitted with a small tap (not shown

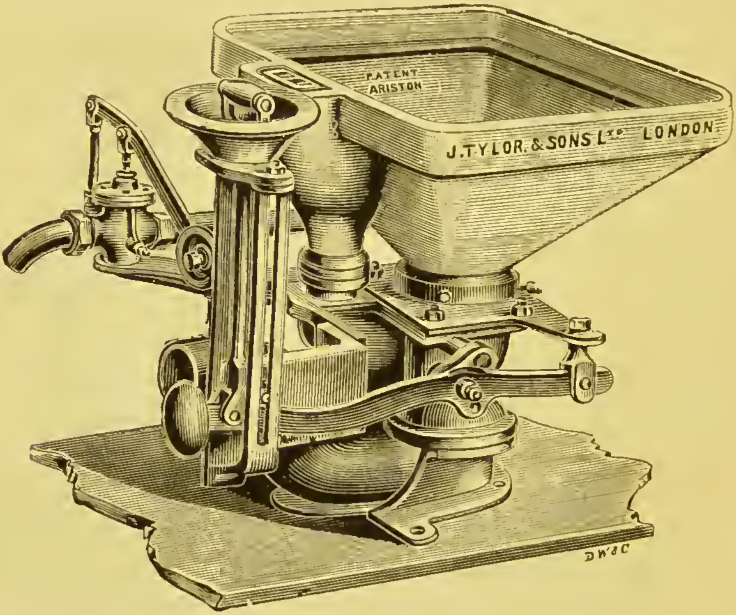


Fig. 36.

in the drawing), is provided for regulating the speed of the descent of the valve-operating lever.

The patent valve-closet, shown in Fig. 36, is fitted with a lead trap arranged above the floor-level. The parallel action pull, the regulator valve, and the weir overflow, are substantially similar to those described with reference to Fig. 34. The basin is of a square or rectangular shape, and of large area at the top, thereby rendering it adapted for use as a slop-sink without necessitating its being fitted with an earthenware cover or slop-top. The basin has a flushing rim, and the lead trap is so designed as to be reversible.

Fig. 37 illustrates a patent valve-closet (Roger Field's patent). This closet is fitted with a handsome brass collar and pull-up, the patent parallel motion, a china basin with flushing rim of an improved form, and an after-flush arrangement for trapping. The valve-box is enamelled on the interior to prevent corrosion. The overflow arrangement consists in a weir formed in the side of the basin (shown on the right-hand side of the drawing), and having a lip by means of which the excess of water is conducted or delivered on to the lead tray or safe which is fixed below the apparatus; this tray or safe must in this case be formed extra deep, and be provided with a waste pipe of ample bore to carry off any water that may pass over

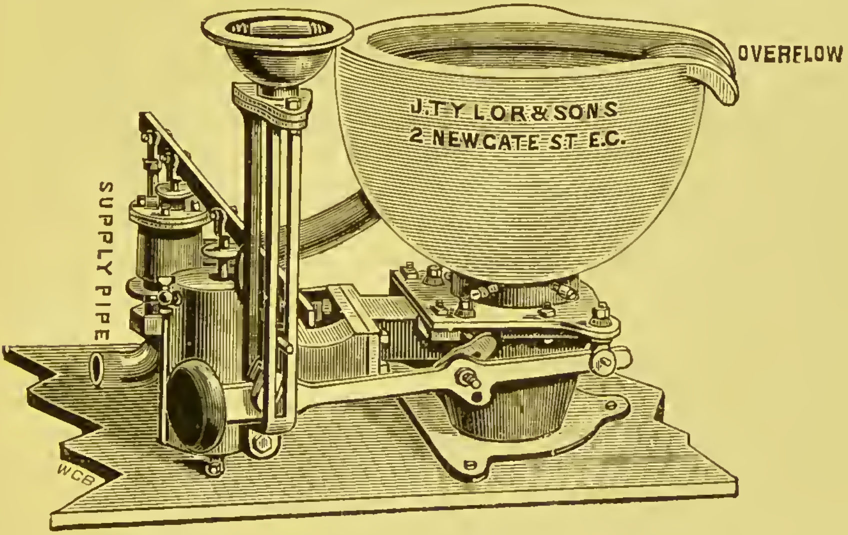


Fig. 37

the overflow weir. It will be obvious that a closet fitted with a basin having an overflow of this pattern must not be used for slops. If this latter rule be strictly adhered to, no better form of overflow can be employed, as there is no chance of fouling taking place, such as may occur when the said overflow is connected with the box or trap of the closet.

In the above closets the valves are of that kind or class wherein a metal disc is supported on an arm or lever, and is moved to and from the seating on the outgo from the basin by means of a spindle rotatably mounted in suitable bearings provided in the sides of the valve-box, and having firmly secured on its projecting extremity a slotted crank-arm connected by a stud or pin with a weighted lever pivoted at one end to the valve-box cover, and coupled at or near the other end to the pull. When this latter lever is raised through the medium of the said pull, the valve is moved away from its seating, or opened to permit the discharge of the contents of the basin taking place. On the release of the pull the lever is returned to its normal position by gravity, and the valve is closed and retained firmly against its seating, so as to form a tight joint, by the counterweight upon the free end of the said lever. The metal discs or plates forming the valves are usually provided with discs or rings of india-rubber to facilitate the formation of a water-tight joint.

Many other forms of valves have been designed which space does not admit of mentioning in this little book. Mention may be made, however, of one of extremely novel design, for which a patent was granted in 1887. In this arrangement the valve consists in a metal tube fitted to rotate within another tube. Both these tubes have formed in them a hole or aperture of sufficient dimensions, and the outgo from the closet-basin is to be connected to the outer tube in such a manner that the said outgo will be coincident with the hole or aperture in the said outer tube. It will be readily understood that by imparting to the inner tube or valve a half-turn in one or the other direction, the aperture to the basin can be closed or opened. One of the advantages claimed by the inventor for this pattern of closet-valve is that it cannot become choked, and prevented from closing properly upon its seating by pieces of paper or other matter, as, should any such substance remain in the aperture, it would be cut or shorn off during the closing movement. The inconvenience caused by the failure of trapping the after-flush in the basin is thus avoided.

A closet having some novel features, and known as the "Twin Basin Valve Closet," has been invented by a Mr. Pearson. This closet is a combination of a wash or flush-out and a valve-closet. It comprises a double basin, or a basin having two compartments, one of which is beneath the aperture in the seat, and communicates with the other compartment, which latter is underneath the casing, and is connected directly with the soil-pipe, with or without the interposition of a suitable trap, but is normally closed by a plug-valve, so coupled or connected by a vertical rod to a handle or pull, as to be under control of the user of the closet. In the latter compartment is fitted, moreover, a ball-cock or valve, retained normally in a closed position by the body of water contained in the said compartment. This ball-cock or valve governs the supply of water to the flushing-rim of the first or main basin or compartment. When the plug-valve in the second or auxiliary compartment or basin is opened, the body of water in the latter escapes, and the ball or float descending, a flow of water takes place through the said ball-cock or valve and flushing-rim, so long as the said plug-valve is kept open, and the contents of the other compartment are washed out by the said flush and pass down the soil-pipe. The above closet is usually fitted with a lead urinal or slop-top.

**The Wash or Flush-out Closet.**—The wash or flush-out closet is of the type known as "pedestal," that is, it is uninclosed, and made of sufficient strength to support a hinged wooden flap-seat. The basin and trap are either formed in one piece, or they may be constructed in separate pieces, and the basin is provided with a dip or well, in which a lodgment of water takes place, and into which the excreta falls when the closet is used; the outlet to the trap is partially concealed from view. This class of closet was in extensive use up to a comparatively short time back, and was highly esteemed by some first-class authorities on sanitary matters. It has, however, of late fallen, in some quarters, into a certain amount of disrepute. The chief objections raised to this class of closet are that fouling of the basin is apt to occur, and that the trap is not so well cleared as where the flush descends directly into it, and its initial velocity is not lost or impaired in clearing the dip or well in the basin. Moreover, the fact of the outlet being mostly concealed from view, if it adds somewhat to the appearance of the basin when new, is, on the other hand, highly objectionable, inasmuch as it admits of the said outlet becoming foul without the fact being noticeable to those using the closet.

Numbers of these closets are, however, still in use, and they are even now advocated by many, and, if of an improved design, appear to give satisfaction. Undoubtedly the above-named faults can be, to a great extent, overcome by paying a proper attention to the design, and constructing the basins and wells or dips therein on such lines as to ensure their being as self-clearing and cleansing as possible.

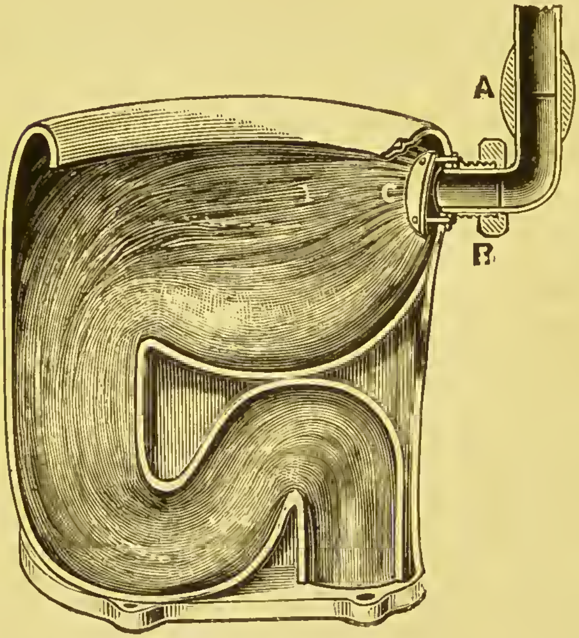


Fig. 38.

Fig. 38 illustrates in vertical central section a wash or flush-out closet patented by Mr. Milton Syer, London. The basin and trap, which latter is of an S pattern, are of earthenware, and are constructed in one piece, on easy lines, and the dip in the basin forming the well is so arranged as to offer the least possible obstruction to the flush. The basin is formed without an arm, thereby avoiding the liability of the latter being broken off by frost. The down or service-pipe is connected by a strong wiped joint indicated at A, to a brass bent inlet arm, which latter is connected by means of a screw cap or union, shown at B, to a special metal spreader C fitted in a hole or aperture provided in the basin. This arrangement admits of the basin being used with a right or left-hand, or a straight supply, and the use of an india-rubber or putty joint is dispensed with. The clearing action of the flush is shown in the drawing.

Figs. 39 and 40 show two flush or wash-out basins designed by Messrs. G. Farmiloe and Sons, London. The basins are provided with S traps, and are constructed separate from the said traps, and that shown in Fig. 40 has a ventilating or anti-syphonage pipe-socket. Either of these basins can be fitted with a P trap if desired.

Amongst other advantages claimed for these closets are the following :—The very efficient water-seals in the traps. The traps themselves exceptionally small in cross section, thereby reducing the quantity of water requiring displacement to little more than half the usual quantity—a very important consideration where the flush is limited to two gallons. The extreme contraction of the traps and easy curves employed which impart a high velocity, and consequently great scouring power to the flush, the heaviest as well as the lightest charges being readily disposed of, and every portion of the basins thoroughly cleansed. The dead water in the basins unusually deep, and the front thereof curved to the form taken by the fall of the water, thereby tending to avoid the soiling often complained of in these kinds of closets. The bevelled rims admit of the closets being used as slop-closets or urinals without inconvenience.

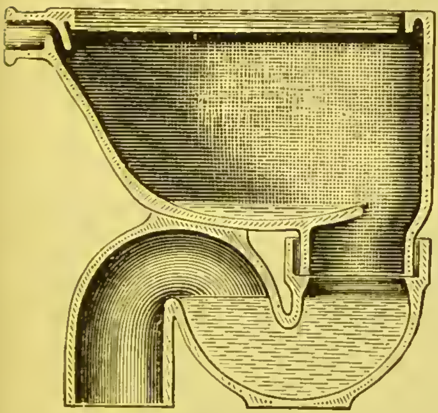


Fig. 39.

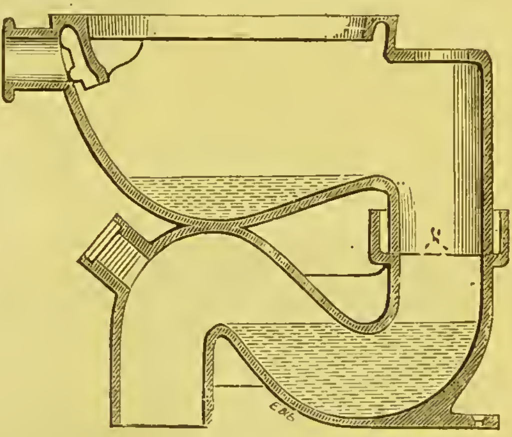


Fig. 40.

**The Wash or Flush-down Closet.**—When constructed on true sanitary principles this closet is (as already mentioned) the best for all-round use in private dwelling-houses. Similarly to the wash or flush-out closet, it is of the "pedestal" type, and may be formed either in one piece with the trap or separate therefrom. These closets are known by some makers as " Pedestal Hopper Closets." As before mentioned, the forms of the basins and traps are important points, as if the said basins and traps be not designed with the proper sweep they will be perpetually giving trouble by fouling.

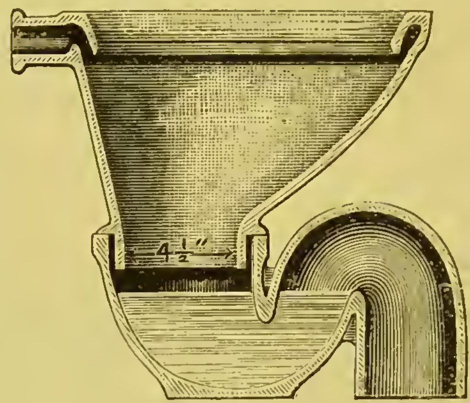


Fig. 41.

An objection to this form of water-closet is that, there being only one trap (instead of two, as in the valve-closet), should any leakage take place, or should the water in the trap be removed by syphonage (where several closets are connected to the same soil-pipe, or from a large body of water being suddenly discharged into it from a bucket, slop-pail, or the like), or in case the closet should not be used

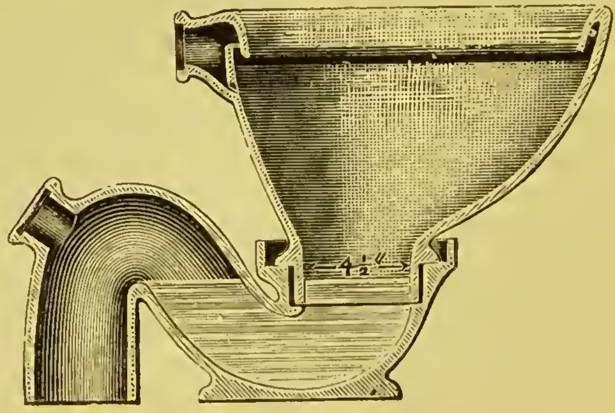


Fig. 42.

for a length of time, by evaporation, there is nothing to prevent the foul sewer-gases escaping from the soil-drain into the house. The previously-described class of closets (wash or flush-down closets) are naturally, from their construction, equally liable to these accidents. The first of these defects (leakage) is a very unlikely occurrence, as in the case of a stoneware or earthenware trap it would be absolutely impossible, unless the trap were actually fractured, in the case of an enamelled iron trap, unless faulty to start with, it would have to become corroded right through, and in the case of a lead trap it would have to become punctured in some manner. When lead traps are used, however, they should always be drawn and not cast, as the latter are liable to be defective through blow-holes. The second (syphonage) is easily obviated by the provision of a proper anti-syphonage pipe; and the third (evaporation) would require the

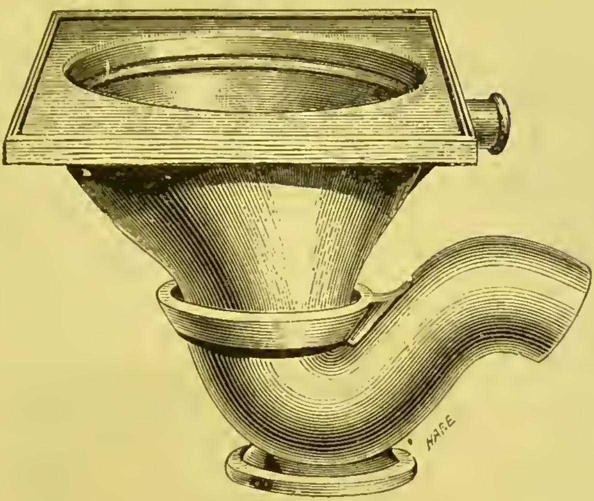


Fig. 43.

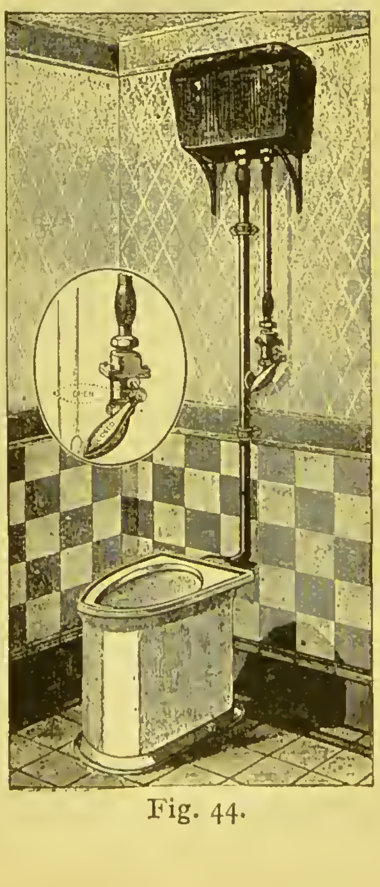


Fig. 44.

closet to have been left unused for a very long period, and is only likely to occur in the case of an unoccupied and neglected house.

Figs. 41, 42, and 43 show three patterns of flush-down closets, also designed by Messrs. G. Farmiloe & Sons. In all three patterns the basins are constructed separate from the traps, Figs. 41 and 42 showing S traps, and Fig. 43 a P trap. The trap shown in Fig. 42 is provided with a socket for a ventilating or anti-syphonage pipe. The basins have flushing-rims, and that shown in Fig. 43 has a square fixed slop-top, thus rendering it suitable for use as a slop-sink when desired.

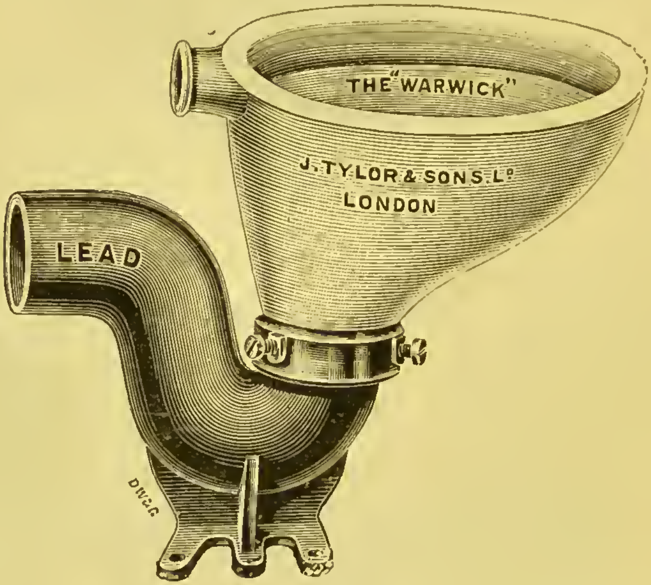


Fig. 45.

Fig. 44 illustrates a flush or wash-down pedestal-closet, designed by Mr. J. Jones, Chelsea. The closet is shown ready fixed for use, and fitted with one of Jones's Patent Water-Waste Preventers, particulars of which will be found under that head (see Fig. 100). The closet is compact and well designed; there is a large surface of water in the basin, and the trap is of uniform size of bore throughout, and its formation is such as to leave no corner where soil can become deposited. The outlet from the trap is so arranged as to be concentric with the basin, thereby enabling this closet to be used for replacing one of the old condemned pan-type of closet with the minimum amount of expense.

Figs. 45, 46, and 47 show three patterns of wash or flush-down closets, designed and made by Messrs. Tylor and Sons, Limited (London). That shown in Fig. 45 has an earthernware basin, and is fitted with a lead P trap, secured to the outgo of the said basin by means of a brass ring or collar, and set screws, the said joint is placed well above the water-seal of the trap, thereby obviating the danger of sewer gas passing into the house in case of a faulty joint through careless fixing. The basin is formed almost vertical to the rear to avoid fouling, and the front is taken down to the outgo in an easy sweep. The trap being of lead facilitates the formation of a sound joint between it and the soil-pipe branch. A ventilating or anti-syphonage pipe should be carried up from the top or crown of the trap.

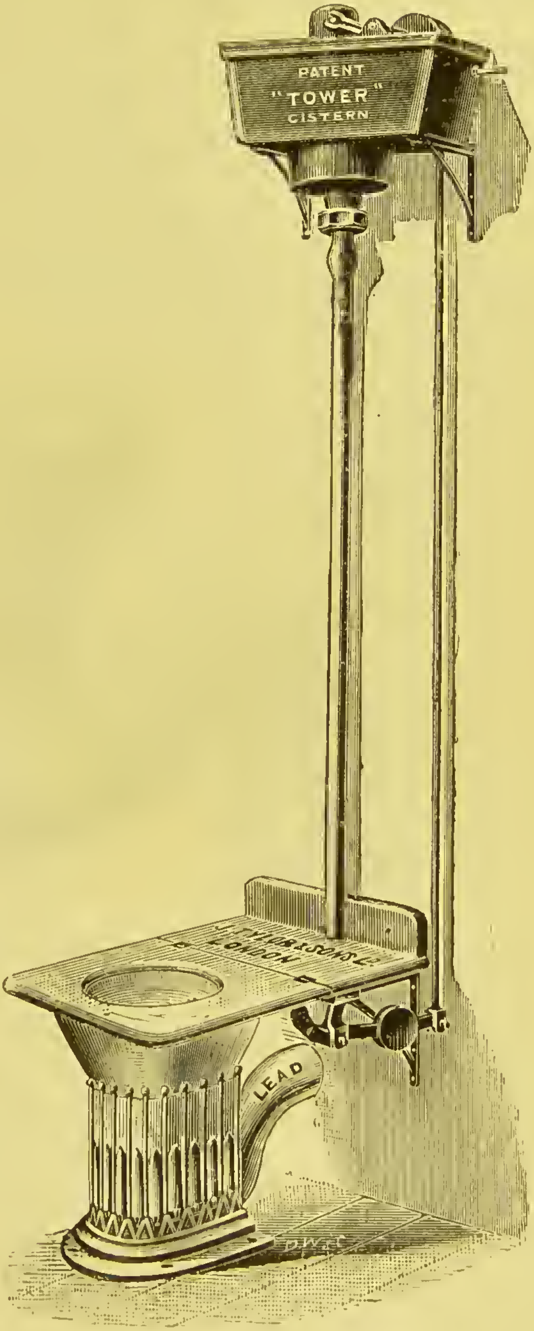


Fig. 46.

The closet, illustrated in Fig. 46, is a patent form of pedestal closet. It is shown in the drawing as fixed ready for use, and fitted with a seat action, that is to say, the hinged flap-seat is so coupled or connected to the operating lever of a water-waste preventer, that the latter will be set in action each time the said closet is used, a counterbalance weight automatically raising the said seat when the person using the closet rises therefrom. The trap is formed of lead, and the joint between it and the outgo from the basin is above the water-line. The water-waste preventing cistern, shown in the illustration, will be found described under that heading, with reference to Fig. 93.

Fig. 47 shows a closet with an enamelled cast-iron basin and S trap, formed in separate pieces, and connected together by flanges and bolts, with a red-lead, india-rubber insertion, or other joint. The trap is fitted with a cleansing or clearing cover, secured in position by thumb or wing nuts, and having a joint made in a similar manner to that between the basin and trap, and also with a socket for fixing a ventilating or anti-syphonage pipe. The form of basin shown in the illustration is fitted with a spreader (the inlet arm for the flushing or service-pipe is concealed in the drawing), but it is also constructed with a flushing rim. The cleansing or clearing cover can be very easily removed and replaced in position.

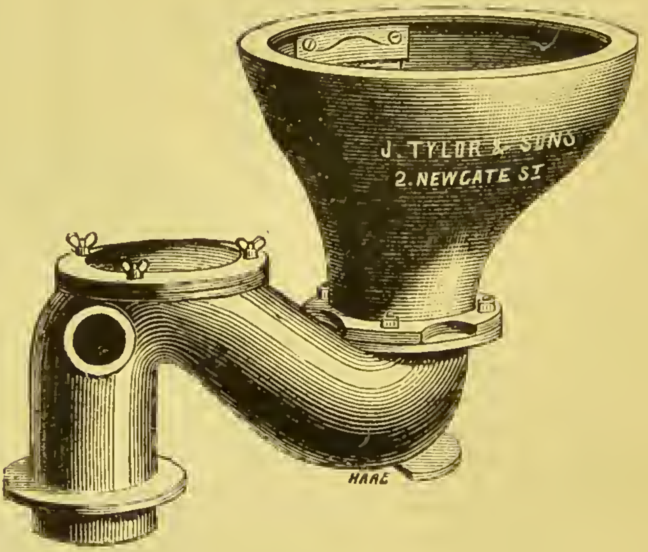


Fig. 47.

**The Syphonic Discharge Wash or Flush-down Closet.**—This type of wash or flush-down closet is only a subdivision of the class previously described (wash or flush-down closets), and it might have been included under that head. There is, however, a very essential difference in the action of clearing the basin and trap when put in operation.

The principle upon which this closet works is that of setting up syphonic action when the flush takes place, which syphonic action operates in a powerful manner to withdraw the contents of the pan or basin, sucking through the intercepting trap the water resulting from the flush, and also the other contents of the said basin.

These closets are efficient in their action, insomuch as having great self-cleansing and clearing powers. A syphonic closet must be fitted with a water-waste preventer, having a main flush and an after-flush, or some other arrangement for securing an after-flush to charge the basin and trap must be provided.

Fig. 48 shows a syphonic closet made by Messrs. Winser & Co., Pimlico. The basin has a flushing rim, and both it and the syphon or trap are formed of earthenware, in one piece, and are of the pedestal pattern, the connection between the outgo of the earthenware trap and the soil-pipe branch can be easily made, and a perfectly sound joint ensured by soldering it to the lead safe or tray beneath the closet, or by forming a flange on same, which can be firmly clipped (as shown in the drawing) between the underside of the closet and the floor, and a perfectly tight joint thus formed.

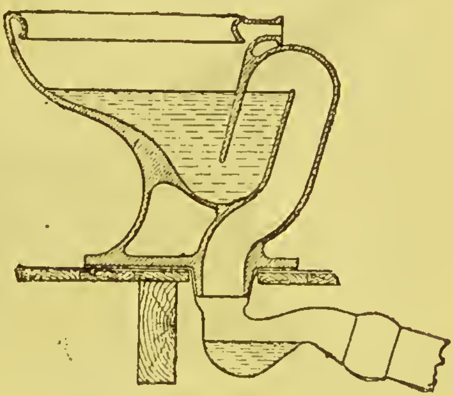


Fig. 48.

As will be seen from the drawing, a dip or bend is provided in the connection between the trap or syphon, and the soil-pipe branch, and the bore of the pipe above it, on the soil-pipe side of the said bend or dip, is slightly reduced. A certain amount of water remains in the well or recess formed by this bend or dip, and this, together with the said reduction in the bore of the pipe, admits of syphonic action being set up in the trap to forcibly clear or suck out the entire contents of the basin, directly a certain predetermined amount of water passes into the said syphon or trap during the flushing of the closet.

If this bend or dip and reduction were not provided in the soil-pipe branch, or the connection thereto, too large an amount of the flushing water would be consumed in glutting the trap or syphon and starting its action.

Fig. 48A illustrates a syphonic discharge closet made by Mr. George Jennings, Lambeth (Jennings and Morley's Patent), which combines a water-closet, urinal, and slop-sink. It will be seen from the drawing that the down or service pipe from the flushing cistern is provided with two connections to the basin, the one being connected with the flushing rim of the latter in the usual manner, whilst the other is connected to the top of the long leg of the syphon marked D in the drawing. E is a puff or relief pipe for admitting of the escape of the air

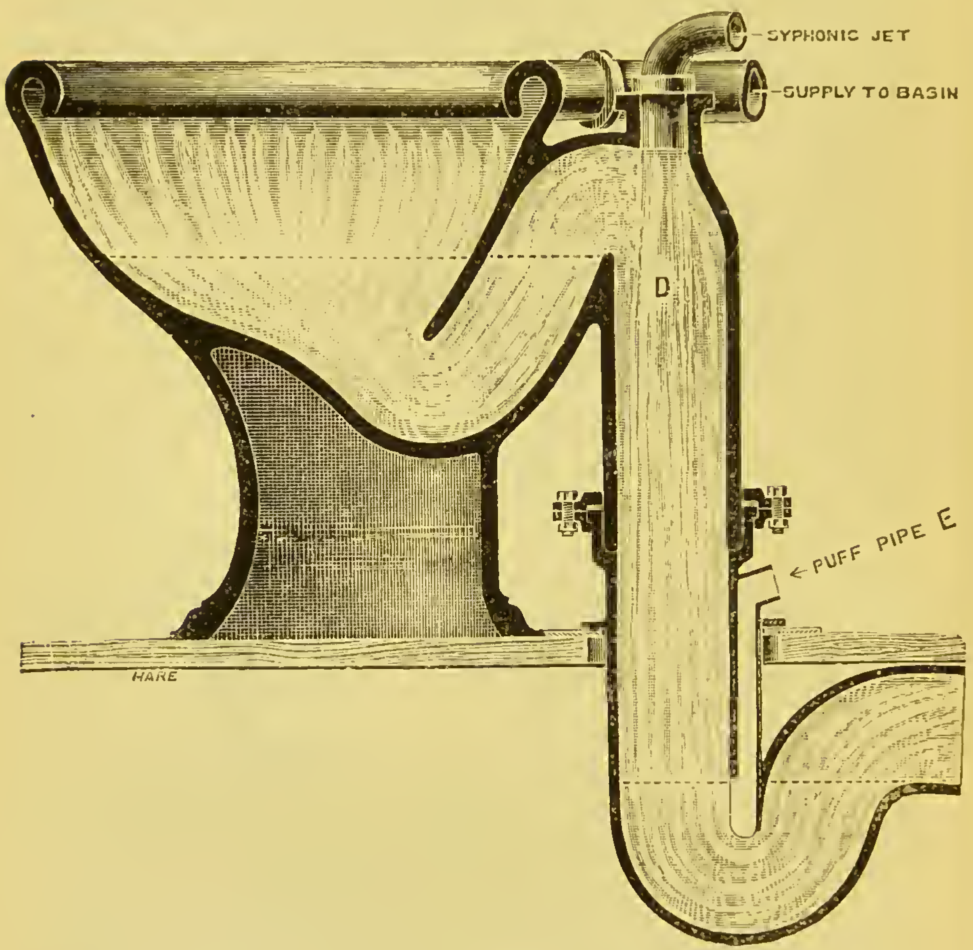


Fig. 48A.

from the said syphon when started. The flush from the cistern is thus, it will be seen, divided into two streams, one stream passing through the flushing rim and scouring the basin, and the other rushing down the leg D expelling the air contained therein through the said puff or relief pipe, and starting the syphonic action to forcibly suck or draw out the entire contents of the said basin. The basin is recharged with water by the after-flush from the cistern. The body of dead water in the basin has a depth of six inches, a surface area of twelve inches by ten inches, and the depth of the seal is three inches. The outgo from the basin is coupled to the lead trap by means of a special patented outlet joint, thus forming an absolute and permanent air-tight connection thereto.

When the closet is fixed over a shallow trap, a suitable pipe must be provided for preventing the syphonage of the basin taking place whilst slops are being emptied into it. This pipe should be connected to the syphonic leg D and taken through the external wall and connected to the main ventilation pipe or shaft above the highest fittings, or continued up above the roof of the house. When the closet is fixed over a trap having a two-inch anti-syphonage pipe, either a pipe or valve may be used, and if the first be employed it may be either taken through the external wall, or fixed inside parallel with the down or service pipe from the cistern. These closets are in use in municipal and other public buildings, clubs, institutions, and in many private residences, and are made in a great number of different patterns and materials, suitable for various requirements.

**The Trough Closet or Latrine.**—Trough closets or latrines, or combined closets, are adapted for use in barracks, police-stations, colleges, board-schools, factories, workhouse unions, and other places where large numbers of persons are congregated, and consequently extensive water-closet accommodation is required.

A range of trough closets usually consists in a long iron or stoneware trough running beneath the seats of a large number of separate compartments or closets, or a continuous seat having a number of apertures, the said trough being flushed a predetermined number of times during each day automatically or otherwise. If trough closets are not flushed at sufficiently frequent intervals, and are not otherwise looked after, they are apt to become intolerably offensive. The walls of the troughs become

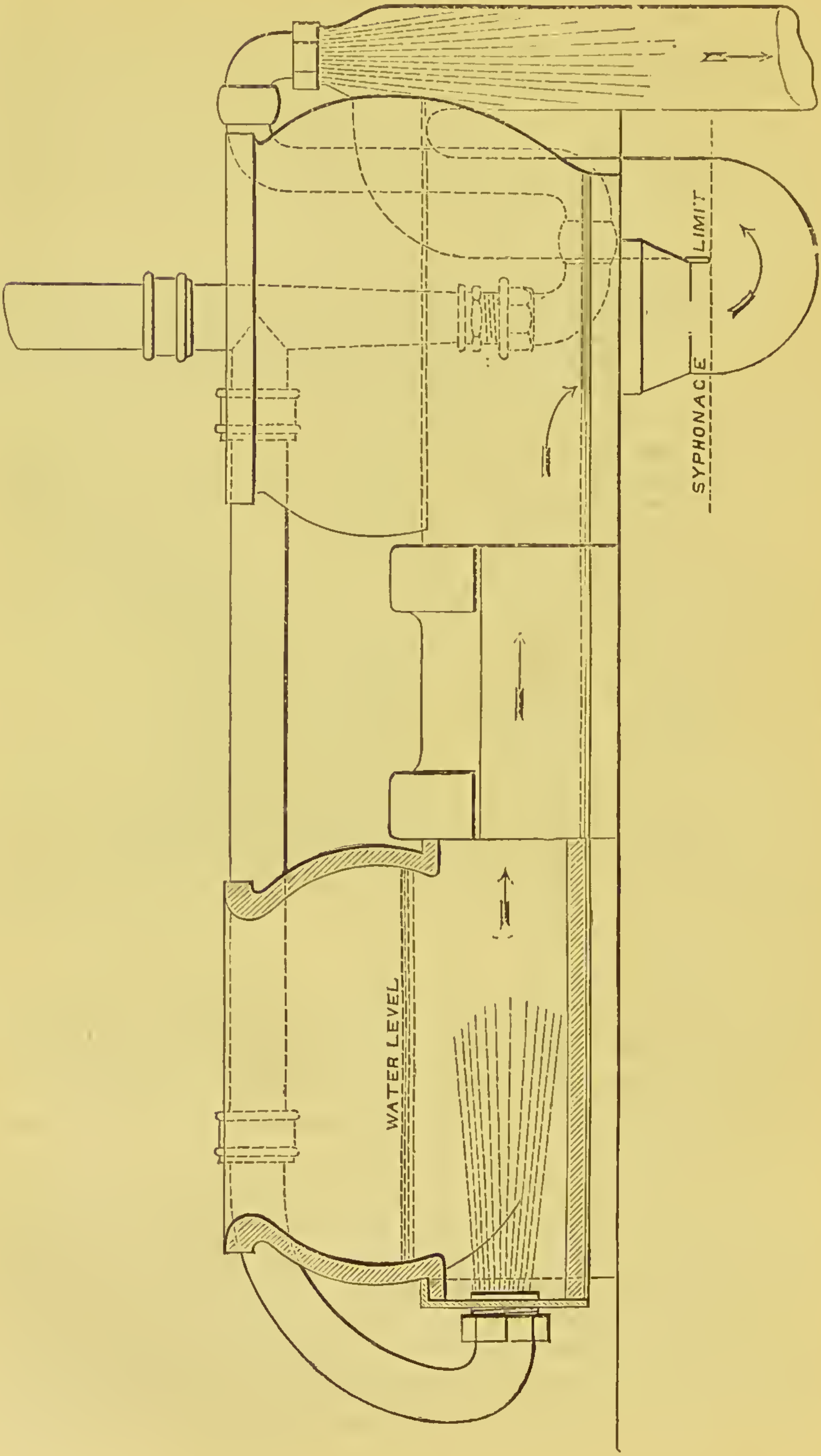


Fig. 48B.

encrusted with deposits from the fæces and urine, and the beds of the said troughs remain full of excrementitious matters, thus causing the atmosphere of the closets to be loaded with stenches of the foulest possible description, and not infrequently becoming the cause of contagion and disease. Trough closets should be flushed at least once in every hour during the day, and the amount of water discharged at each flush into the trough should be sufficient to displace the whole of the contents of the said trough, a flush (properly directed) of from eighty to one hundred gallons, or about ten to twelve gallons per seat being required to cleanse a trough twenty-four feet long.

When properly flushed and otherwise attended to, trough closets need not be condemned on sanitary grounds, but where water is expensive they are frequently objected to on account of this large amount of water that has to be consumed to maintain them in a sanitary condition.

A latrine or trough closet, on the syphonic discharge principle, designed by Mr. G. Jennings, is shown in Fig. 48B. This closet consists essentially in basins or pans of highly-glazed vitrified stoneware, or of enamelled iron, having a large water surface and connected together by means of stoneware, or cast-iron pipes. The discharge and overflow valves are preferably placed in the closet set apart for the master, foreman, or other person in authority, which closet is situated at one end of the range, and may be kept locked. The latrines must be connected with an automatic syphon flushing tank, having an arrangement for ensuring an efficient after-flush, and capable of being adjusted to operate at any desired intervals.

The operation of this apparatus is as follows, that is to say, at each discharge of the automatic flushing tank the water escapes through the outlet and also through a branch-pipe terminating at the further end of the latrine range, which latter stream is so directed as to drive the contents of the pans towards the outlet. At the same time a jet of water passing through the other branch and entering immediately at the top of the straight discharge-pipe is so directed by the conformation of this inlet as to glut the latter and exhaust the air, thereby setting up syphonic action through the syphon connecting the first or that pan or basin nearest the said discharge-pipe therewith. This syphonic action is maintained until the whole contents of the range of pans or basins down to the line of syphonage are completely exhausted. The after-flush of the automatic flushing tank or cistern then raises the level

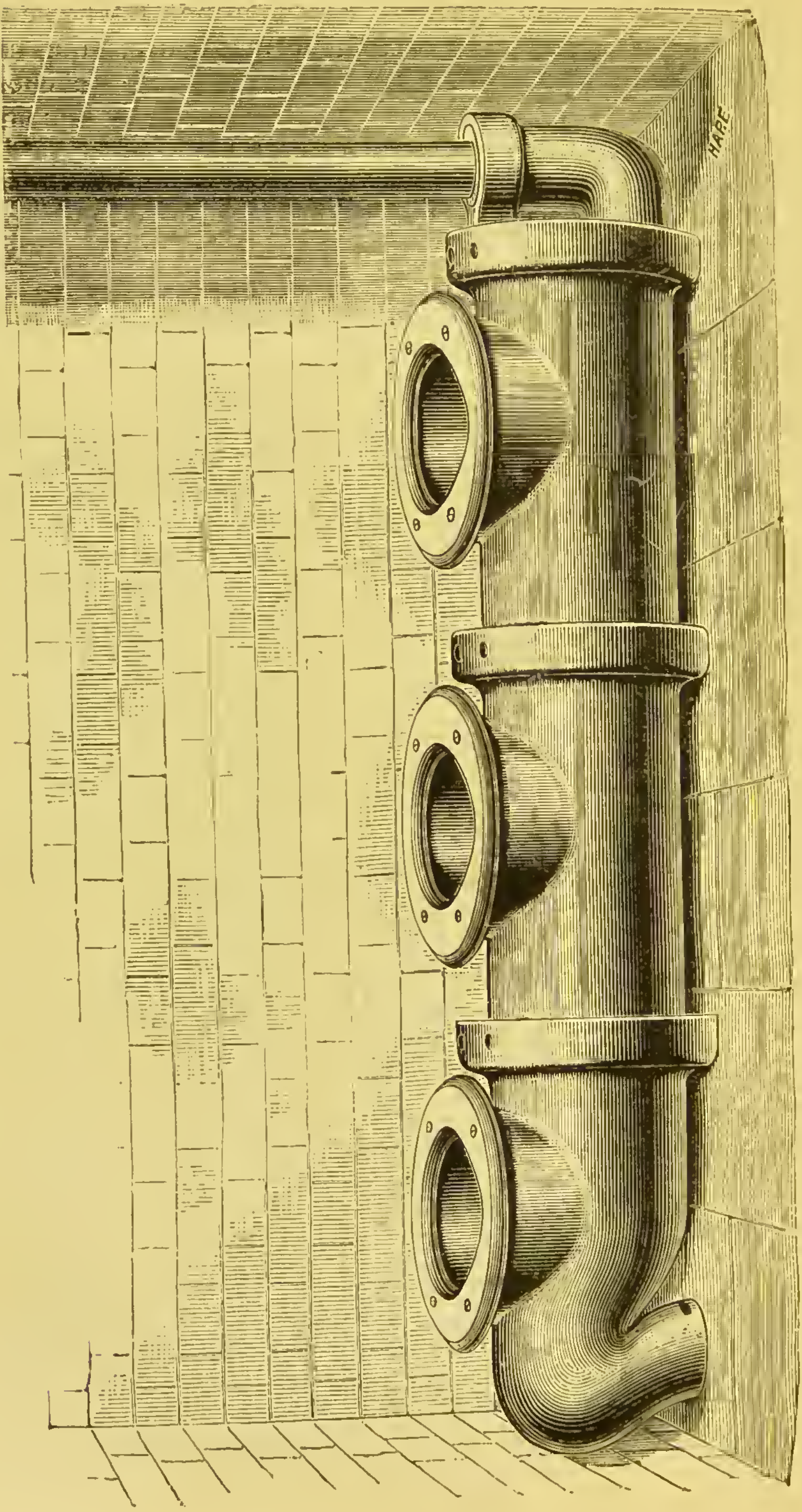


Fig. 49.

of the dead water in the pans or basins to the normal water line.

Fig. 49 illustrates a patent earthenware trough closet made by Messrs. Doulton and Co., London. This closet is simple in design, and can be adapted for the accommodation of any reasonable number of persons. The trough is made in cylindrical-socketed lengths adapted to be put together with cement joints, and each of these lengths has a short flanged branch to which is secured a ring of wood to form a seat. The first of these lengths is fitted with an inlet intended to be connected with the down, service, or flush-pipe from an automatic flushing tank, or cistern, and the last length is provided with an outlet or outgo to be connected with the soil drain, or the branch thereto, and so arranged as to form a weir, to trap or retain a sufficient body of dead water in the trough for the excreta to fall into.

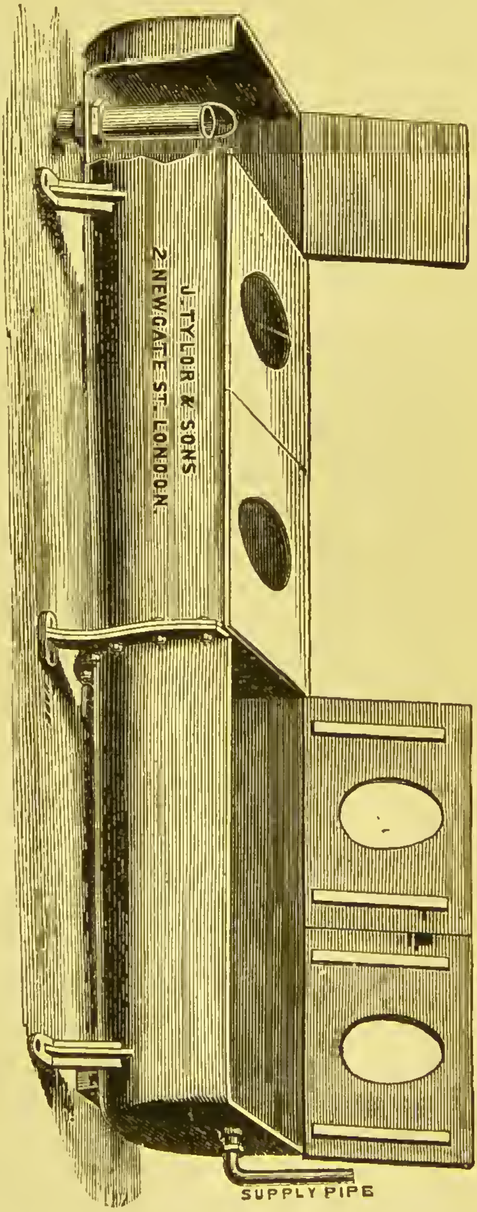


Fig. 50.

Fig. 50 shows a cast-iron trough closet, constructed by Messrs. J. Tylor and Sons, London. This closet consists in a trough of a semi-cylindrical shape in transverse section, formed in flanged sections, and having short feet or legs, by means of which it is so supported as to rest clear of the ground, thereby admitting of a thorough cleansing being effected all round, and permitting the occurrence of any leakage in the joints between the sections or elsewhere to be instantly detected. The sections are fitted with hinged wooden seats, which can be raised, as shown in the drawing, so as to admit of access being obtained to the interior of the trough for cleansing or other purposes. The first section of the trough is closed at its outer end, and is fitted with a water-supply or flushing pipe; and the last section of the said trough is also closed at its outer end, and is fitted with a waste-plug which also forms an overflow. This plug has a separate lock-up cover, and when the trough is flushed the said plug must be lifted clear away so that the whole trough can be thoroughly cleansed. When in use the water stands normally up to the level of the overflow pipe.

**The Slop or Waste Closet.**—The class of closets known under the above title are intended to be intermittingly flushed throughout the day by the water that has been employed for washing the person or clothes, or for other domestic use. To use this water to any advantage it must be collected and stored until a certain quantity is obtained, and the body of water be then suddenly and automatically discharged into the closet. This end is usually attained by employing a tipper—that is to say, a vessel or receptacle pivoted in a chamber—and so arranged and balanced that when, but not until, completely full, it will over-balance, and turning upon its pivots suddenly discharge its contents. To accomplish this object the waste-pipes from the scullery sink, bath, &c., are made to empty into a pipe leading to this chamber and discharging into the said tipper, which may be arranged to hold three gallons or any other predetermined quantity of waste or slop-water that may be considered capable of giving a flush sufficient to ensure a useful effect.

This system is obviously valuable for outside closets in rural districts, and especially for the smaller class of cottage dwellings, for which latter indeed it would seem to possess advantages which cannot be overlooked; and it affords a ready and economical means of doing away with the fever-breeding and repugnant cesspools or middens, and other unwholesome and offensive systems.

Fig. 51 is a sectional perspective view showing the complete arrangement of a Patent Slop or Waste Water-closet, designed by Messrs. Oates and Green, Limited, Halifax. As will be seen from the drawing, the waste-pipe from the kitchen or scullery

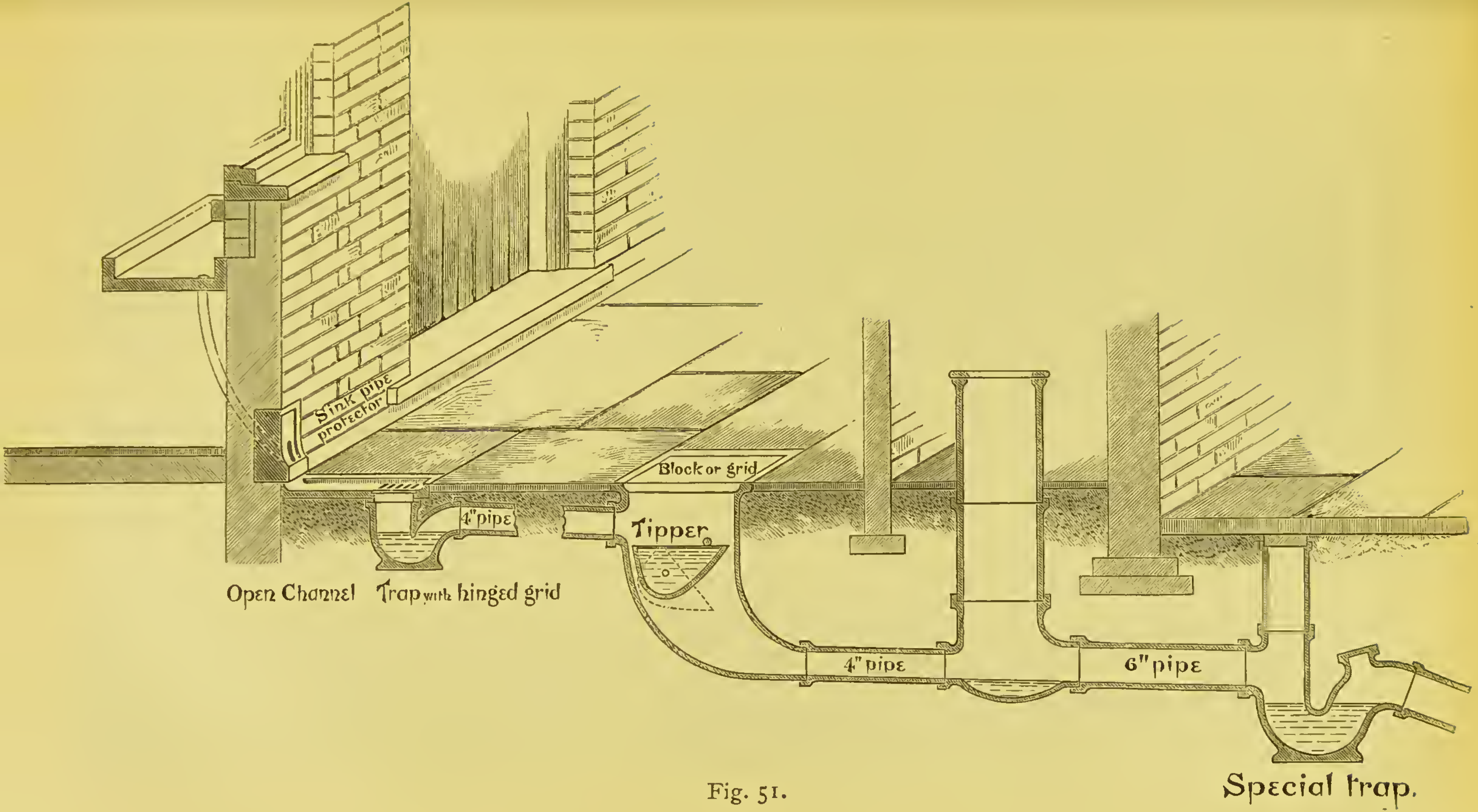

Sink pipe protector
Block or grid
4" pipe
Tipper
Open Channel
Trap with hinged grid
4" pipe
6" pipe
Special trap.

Fig. 51.

sink discharges into an open channel, terminating in a gully trap, with a hinged, or removable grid or grating. This trap is connected by a four-inch pipe with the tipper chamber, the lower end of which is curved, and forms an easy or slow bend, and communicates through another four-inch pipe with the lower extremity of the closet pan; the latter is connected by means of a six-inch pipe with an intercepting trap connected to the drain.

The tipper is so supported on pivots or trunnions in the chamber, that when in its horizontal or normal position it rests against a suitable stop, as shown in full lines in the drawing; but when full it capsizes, or turns on its pivots, and assumes the position shown by the dotted lines in the drawing, so as to suddenly discharge its contents. The upper end of the tipper chamber is closed by a removable block or grid, thus admitting of access being obtained to the said chamber for the inspection and cleansing of, or repairs to, the tipper. A recess or depression is provided in the bottom of the basin forming a well to retain a certain amount of liquid, thereby preventing soiling of the said basin or pan when used. The intercepting or disconnecting trap is provided with two additional access holes or inlets, that communicating with the drain being hermetically closed by means of a suitable plug or cover, and the other being fitted with an access-pipe, which is carried up to the level of the ground, and is also tightly closed by a suitable plug or cover.

# CHAPTER X.

## DRY-EARTH SYSTEM, EARTH, ASH, AND PEAT CLOSETS, AND PRIVIES.

THE idea of employing earth in closets was first thought of by the late Rev. Henry Moule, M.A., of Fordington, Dorset. This gentleman, about the year 1860, was induced to turn his attention to the matter by the necessity of introducing some improvement in the village with which he was connected, which village then had the usual arrangement of cesspits, and was suffering from the troubles and diseases commonly attendant upon this system. Mr. Moule devised a simple form of apparatus for use in the closets throughout the village, which, if crude in design, was yet the germ from which has sprung the comparatively perfect apparatus now manufactured by Moule's Patent Earth Closet Company, Limited, London. It is possible that the reverend gentleman may have first taken his idea from the Bible, where we find in Deuteronomy very explicit directions given by that most eminent of early sanitarians, Moses, which prove that he was perfectly acquainted with the value of earth as a deodoriser and disinfectant, and was fully alive to the necessity of proper sanitary precautions being adopted where large numbers of people were congregated together.

The earth system has been defined in the following manner by Dr. Buchanan in a report "On the Dry-Earth System of Dealing with Excrement," forming part of the Appendix to the Twelfth Report of the Medical Officer of the Privy Council, published in September, 1870:—"It is desirable to begin with a definition of the dry-earth system. It consists in the application, with the greatest procurable detail, of dry earth to fresh human excrement, and in the subsequent removal and use of the mixture for agricultural purposes. In so far as detailed application is not made, or as the earth is not dry, or the excrement not fresh, or the mixture otherwise dealt with, the dry-earth system is departed from. It is essential that this definition should be kept in mind, as allegations respecting the action of the dry-earth system have been made from the experience of places where the primary conditions of the system have scarcely been attempted to be fulfilled.

"As regards the principle of the earth closet, the evidence as to the powers of dry earth is unequivocal. If about a pound and a-half of suitable earth, carefully dried, be thrown over a dejection, all smell from it is forthwith removed, and if the same quantity be mixed with half-a-pint of urine the latter is absorbed. The mixture of earth with stool and urine is not only inoffensive when fresh, but remains so after keeping for two or three months or longer.

"The process which goes on in the mixture is obviously one of disintegration and of some combination between the earth and the organic matter, as is evidenced by the disappearance of stools, and even of paper, among the other constituents of the compost. But the absence of fœtor from the mixture of earth with stool or urine, even with prolonged keeping, shows that decomposition in the ordinary sense does not take place."

By the proper application of a sufficient quantity of dry earth to the stool, the ammoniacal fermentation, which usually commences in the excrement deposited in privy-pits or cesspits in about two hours, is completely arrested.

The principle of the present earth system, therefore, is founded upon this now well-known power which dry earth possesses of thoroughly deodorising, disinfecting, and absorbing fæcal matter, a certain given quantity of earth applied in detail to fresh excrement completely destroying all smell and absorbing all noxious vapours.

The general line upon which most modern closets constructed upon this system work, comprises the employment of a reservoir intended to contain dry earth, peat, or ashes, and provided with mechanism so arranged as to measure and properly deliver, either automatically or otherwise, a regulated and predetermined charge of the material each time the closet is used. The differences between the various patterns are in the details of construction of this reservoir, and the automatic or other delivery mechanism.

Earth, ash, or peat closets are unsuitable for general use in large cities or towns, by reason of the difficulty experienced in removing and dealing with the soil, but they are of undoubted value and utility in small towns and villages, and thinly populated districts, and they are even of greater usefulness in isolated country houses, being equally valuable either in the mansion or cottage, and more particularly in any case where the soil can be utilised as manure.

The first requisite in order to ensure the efficient working of an earth closet is the provision of a proper supply of suitable earth of a loamy nature, perfectly dry and finely sifted ; sand should never be employed, as it possesses but little deodorising, disinfecting, or absorbent qualities.

The best and cheapest mode of procuring the requisite supply of dry earth, is to dry and store up a sufficient supply during the summer months to last through the year. If this cannot be conveniently done, it may either be dried artificially by the kitchen range, in cases where a small supply only is required, or for larger amounts a special stove may be employed.

The amount of earth required to deodorise and disinfect the excrement each time that an earth closet is used is about one and a-half pounds of dry earth, or, say, about one hundredweight of earth per week for every six persons using the closet.

If the earth, after use in the closet, be kept in a dry place for six weeks or so, during which time it has been occasionally turned over, it may be used over again, and this process may be repeated two or three times. It is stated by the manufacturers of earth closets, that earth that had been used experimentally as many as twelve times was found to be perfectly inoffensive. When the earth has been passed through the closet twice or more its value as a manure is greatly enhanced.

Dry peat-dust, ready for use, can be obtained from the manufacturers of peat closets.

Certain clauses contained in the model bye-laws at the end of the book relating to this class of closet should also be perused when dealing with the subject.

**Earth Closets.**—Fig. 52 illustrates an earth closet designed and manufactured by Moule's Patent Earth Closet Company, Limited (London). In this arrangement of closet the charge of earth is delivered from the hopper, shown at the rear of the apparatus, on the pulling up of a handle in the seat of the closet. In using this closet care must be taken to keep the reservoir supplied with fine dry earth of a loamy nature. When a movable receptacle for the filth is employed, after such receptacle has been emptied, a charge of earth should be delivered into the said receptacle before the closet is again used. Where a fixed receptacle or vault is used the heap of filth which is formed immediately under the hole in the seat should be periodically levelled off, and when the said vault has been emptied, a layer of earth, at least two inches thick, should be spread over the bottom before the closet is used. In pulling the handle of the closet care should be taken to do so with a slight jerk in order to ensure the efficient working of the delivery mechanism. On no account should any slops or other liquids be emptied into the receptacle. This closet will work equally well with either earth, ashes, or charcoal.

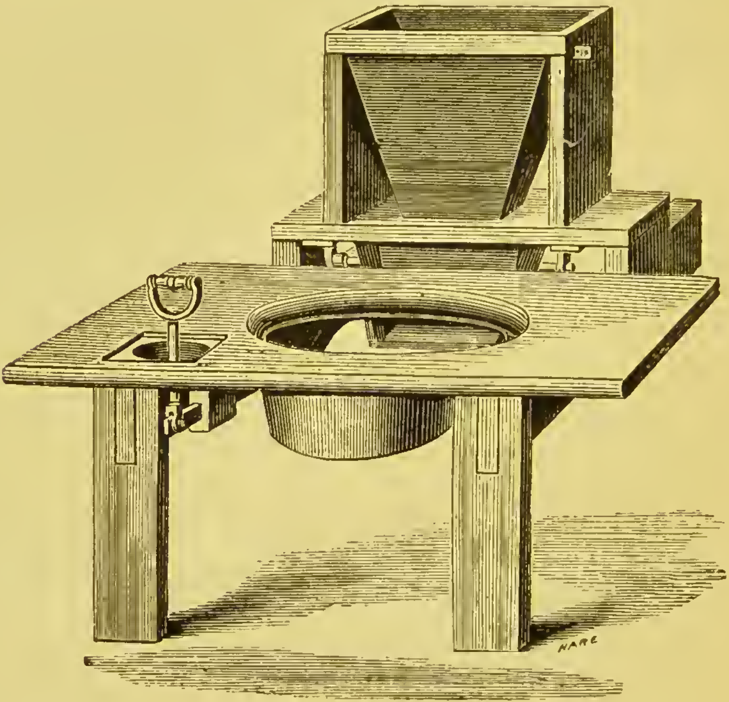


Fig. 52.

The quantity of earth discharged at each operation of the apparatus is about a pint and a-half, thirty-five operations consuming about one cubic foot. When desired, and space permits, the apparatus may be fixed with the earth reservoir carried up to a sufficient height to hold up to three hundred or more charges of earth, and arrangements made to carry on the supplying of the reservoir, from either the inside or the outside of the building as may be desired.

When the closet is fixed upstairs, it should be fitted over a twelve-inch diameter glazed earthenware or stoneware pipe, placed vertically, and the lower end of which terminates above a suitable vault or tank; or a receptacle may be suspended beneath the seat by means of chains. When a vault is used it should be constructed so as to be perfectly watertight. The most suitable dimensions for the vault are as follows, the width should be equal to that of the closet, and it should be about four feet from front to back, and from two to four feet in depth. This vault need not be emptied out until quite full, as the excreta will combine intimately with the earth, and the product be both innoxious and inodorous.

Many other different patterns of earth closets, to meet varying requirements, are manufactured by the same company, which the limited space at disposal will not admit of describing in these pages.

**Ash Closets.**—These do not differ in any material point from those arranged to work with dry earth, indeed, as already mentioned, the closet, illustrated in Fig. 52, will work equally well with ashes as it will with earth, but the former material is far inferior as a deodorising agent, and the value of the manure produced as a fertiliser, when ashes are employed, either by themselves or admixed with earth, is greatly reduced.

**Peat Closets.**—Three forms of patent portable peat-dust closets, manufactured by the Moss Litter and Peat-Dust Closets Company, Limited (F. E. Clotten, Managing Director), London, are illustrated in Figs. 53, 54, and 55. Fig. 53 shows in the foreground a night-soil pan, or barrel fitted with a lid or cover, having an india-rubber insertion and a lever arrangement for forming an hermetical gas- or air-tight joint. The closet shown on the right-hand side is an upright-backed one with automatic action, the lid or cover being so arranged that each time it is closed it will operate suitable mechanism to discharge a sufficient quantity of peat-dust from the reservoir situated in the upright back of the closet, and to sprinkle it on the excrement in the pail. An elongated slot or aperture is formed in the front of the said reservoir, which aperture has a glass plate let into it, thus forming a window through which the amount of dust in the reservoir can be readily ascertained, and the risk of the supply accidentally running short can be thus avoided. The upper part of the reservoir can be opened or removed for filling purposes. The closet shown on the left-hand side is provided with a special lid or cover, which also forms a reservoir, and which is so arranged that each time it is closed a sufficient quantity of the peat-dust is discharged and sprinkled on the excreta in the pail or pan. The action of this reservoir lid is clearly shown in the sectional detail view. These closets can also be readily fixed over existing middens or cesspits by merely removing the bottom boards of the said closets. It is a good plan to provide in this case a large portable galvanised iron tank or barrel fixed on wheels, and to so arrange the midden

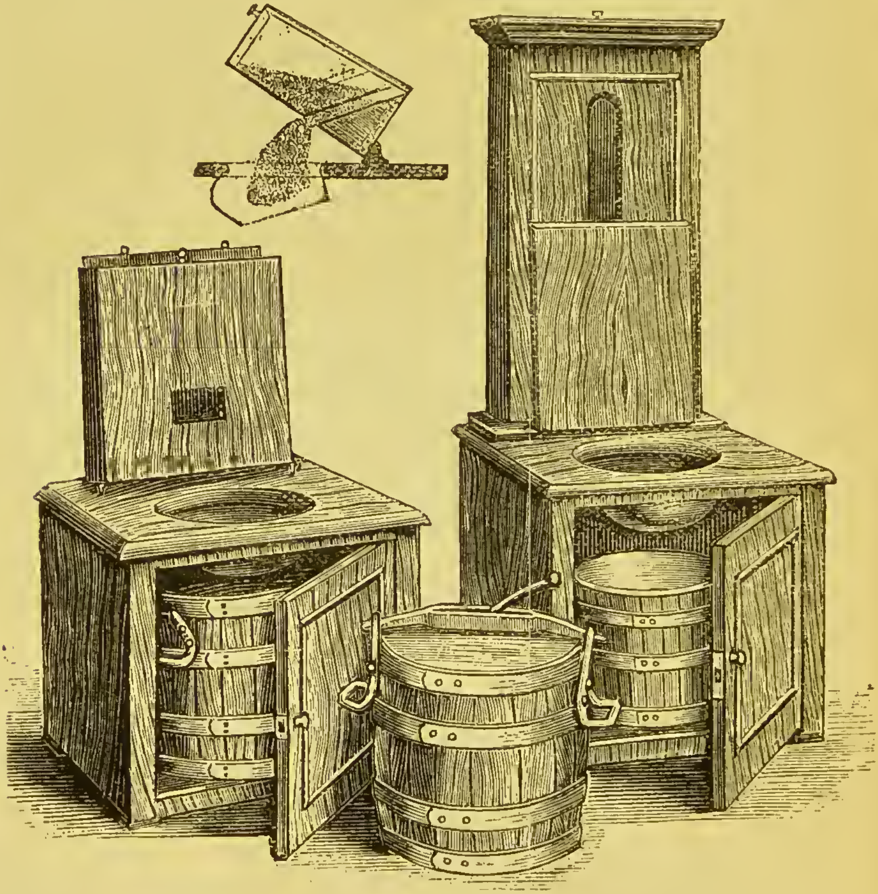


Fig. 53.

or cesspit that this tank or barrel can be introduced below the closet.

Figs. 54 and 55 illustrate a portable peat-dust commode made by the same company. This article is intended to supersede the ordinary commode for use in bedrooms. The seat is movable, and the top cover is provided with an automatic peat-dust sprinkling box, which is substantially similar to that just described. Fig. 55 shows the commode open, and Fig. 54 shows the appearance of the same commode closed.

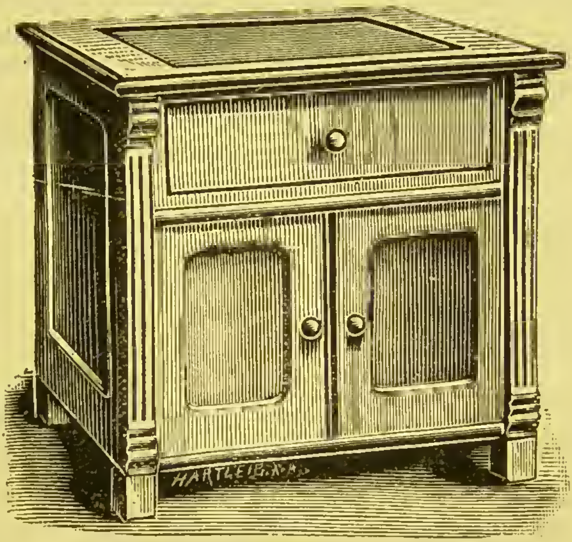

HARTLEIB.N.Y.

Fig. 54.

The above closets are moreover so constructed that, when the lid or dust-box, or reservoir, is down or closed a ventilator will be opened to permit any gases generated in the pail to escape into the said reservoir, and be absorbed and disinfected or purified by the peat-dust contained therein.

Peat-dust is said to form an exceedingly valuable material for use in a dry closet for the following, amongst other reasons :—It absorbs from nine to twelve times its own weight in liquids and retains all ammonia ; it effectually deodorises the most evil-smelling substances, and arrests all ammoniacal fermentation ; it acts as a powerful disinfectant upon foul air or filthy soil, purifying them and destroying

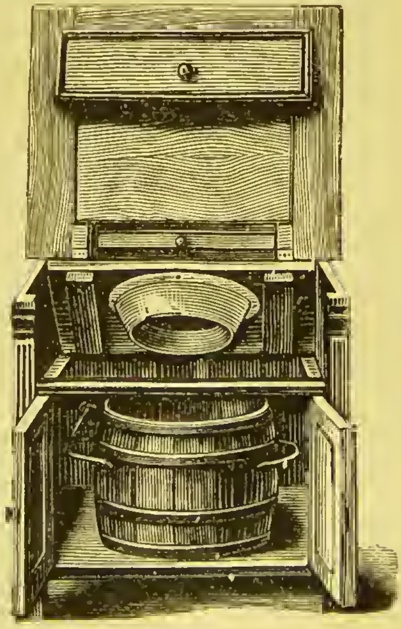


Fig. 55.

fungoid growth. Mixed with human excreta it forms a most valuable nitrogenous manure.

The quantity of dry peat-dust required to supply one of these closets used daily by five or six persons is 2 cwts. In an establishment used daily by 500 people the closets consume ten tons of peat-dust per year.

In cases of virulent infectious diseases it is well to use Bowler's Patent Acidulated Peat-Dust, or to mix some powerful disinfecting powder with the peat-dust previous to putting it into the reservoir or box of the closet.

By the use of a pail having a perfectly gas- and air-tight lid or cover, the night-soil can be removed at any time without inconvenience.

**Value of Human Excrement as Manure.**—The following data bearing upon the value of human excreta in agriculture when used as a manure, and to the effects of peat closet manure on various crops, are extracted from particulars given in publications by Moule's Patent Earth Closet Company, Limited, and by the Moss Litter and Peat-Dust Closets Company, Limited.

According to the first-mentioned firm, the value of earth closet manure has been estimated by various authorities at from two to three pounds per ton when passed but once through the closet. In an experiment made upon an acre of land, a quarter of an acre of swede turnips were manured with 1 cwt. of earth manure which had passed five times through the closet, whilst the remaining three-quarters of the same acre were manured with 3 cwt. of superphosphate (then valued at £7 10s. per ton). The turnips grown on the quarter of an acre with the earth manure weighed one-third more than those grown upon either of the three-quarters of the acre dressed with superphosphate. The whole of this crop was fed off, no other manure was used; and the following year the barley crop was finer on the one-quarter of an acre than on either of the other three-quarters of the acre, in the proportion of four to three.

On another piece of land, earth which had passed seven times through an earth closet was substituted for crushed bones at the rate of 1 cwt. per acre on poor land, and a finer crop of white turnips could not have been grown. Equally favourable results were likewise obtained from other experiments both on field and garden crops.

The following is from data given by the latter company. A year's excreta of a full-grown human being consist on the average of 110 lbs. feces, and 980 lbs. of urine, in all 1,090 lbs. Their chemical composition and manurial value slightly vary, of course, according to age, sex, quantity and quality digested, but the following figures have been found by analysis to be the average quantities of nitrogen, phosphoric acid, and potash contained in the 1,090 lbs.

| | | | |
|---|---|---|---|
| Nitrogen, | in feces, 1½ lb. ; | in urine (as ammonia), 9¼ lbs. ; | total 10¾ lbs. |
| Phosphoric Acid | ,, 1 lb. ; | ,, ⅝ lbs. ; | ,, 1⅝ lbs. |
| Potash | ,, ½ lb. ; | ,, ⅞ lbs. ; | ,, 1⅜ lbs. |

Calculating nitrogen, phosphoric acid, and potash to cost respectively 10d., 3d., and 2d. a lb., a year's excrements of a full-grown human being are worth as manure :—

Nitrogen, 9s. ; Phosphoric Acid, 4½d. ; Potash, 3d. ; in all 9s. 7½d.

**The Effects of Peat Closet Manure on various Crops.**—The Brunswick Government instructed their Agricultural Privy Councillor, Herr Burstenbinder, to experimentally apply peat closet manure to all the principal crops grown in the country under the most varied conditions of soil, and in his report on these experiments Herr Burstenbinder states that results have been uniformly most satisfactory in every respect. He lays particular stress upon the invariably observed fact, that the manurial ingredients contained in human excrements when mixed with peat dust, decompose in the soil more rapidly than farmyard manure and are more quickly absorbed by the plants, consequently requiring to be applied more frequently, though in smaller quantities than farmyard manure. He further specially points out the considerable advantages of the use of peat closet manure by market gardeners who desire to rapidly bring on their crops so as to reap the benefit of very early marketing.

The quantity of peat closet manure applied to the land may vary from two to ten tons per acre, according to nature of soil and of crops to be grown.

With an application of five tons of such manure, an acre of cold stiff clay yielded a better crop of oats than was got from an acre of light loamy land in good manurial condition.

The following results of an experiment made at Herrenhausen, near Hanover, illustrate the benefit derived from a heavy dressing of peat closet manure for potatoe growing :—

| Manure applied per acre. | On sterile sandy soil. | On medium light soil. | On good sandy loam. |
|---|---|---|---|
| 3½ tons | 32½ cwt. | 57½ cwt. | 120 cwt. |
| 10 ,, | 95 ,, | 125 ,, | 190 ,, |

For sandy or light loamy soil this peat closet manure is pre-eminently profitable, adding to such soil not only readily assimilable manurial ingredients of highest value, but moreover that valuable substance for consolidating and permanently improving sandy soil : humus.

Cold stiff clay lands are made more porous, allowing of better aërated and easier cultivation.

It may likewise be stated here, that the application of peat closet manure, as also of peat moss litter manure, in no way encourages the growth of mosses, as many farmers are inclined to believe.

Beans, peas and vetches sown on sandy soil previously dressed with from three tons of peat closet manure yielded heavy crops notwithstanding a severe drought, whereas on the adjoining piece of like soil, which had been dressed with three tons of farmyard manure, these leguminosae suffered severely from the drought and produced in every respect very poor crops.

On the crown estate of Linden, near Brunswick, heavy clay land dressed with five tons of peat closet manure per acre, yielded the same wheat crop as a similar piece of the same land dressed with ten tons of farmyard manure, while the quantity of straw produced on the former piece was considerably greater than that on the latter.

On the farm attached to the great Prussian State Prison at Vechta, light sandy soil manured with the peat closet manure yielded 15½ times the quantity of rye sown out, whereas dressed with an equal quantity of farmyard manure, the crop was only 10⅔ fold.

The growth and production of vines, fruit trees, and every kind of vegetables is most appreciably improved by a liberal application of peat closet manure.

The grapes from vines dressed with both stable and artificial manures analysed only 76° oechsle of grape sugar, whereas the grapes from vines dressed with peat closet manure contained 87° oechsle grape sugar ; besides the latter grapes had ripened earlier and developed larger berries.

For asparagus growing on light sandy soil, or in sandy loam, this peat closet manure has proved of exceptional value.

An asparagus bed, covering about 170 square yards—soil a light sandy loam—the production of which had proved very disappointing, notwithstanding liberal dressings with farmyard manure, on being dressed with an equal quantity of peat closet manure, yielded within six weeks 2 cwts. of plump, fleshy asparagus of finest quality.

All kinds of kitchen garden vegetables, as also cucumbers and tomatoes have invariably derived the most substantial benefit from a liberal peat closet manure dressing. Moreover the growth has been more rapid, enabling an unusually early marketing of the produce.

Nurserymen have found that by mixing equal quantities of peat closet manure and ordinary soil they are able to produce surprisingly splendid results in the growth of camelias, azaleas, laurels, rhododendrons, roses, and other garden plants, which they cannot obtain by using any other manure.

**The Disposal of House-slops, &c., where the Earth System is in Use.**—This is a matter which, in the larger classes of country residences, demands some serious consideration when a system of dry earth closets is installed, and the following plan has been adopted by Mr. H. J. Girdlestone, C.E., Engineer to Moule's Patent Earth Closet Company, with success. The slops from the house are discharged into a Field's patent self-acting, or other suitable automatic flushing tank or cistern, having a drain formed of well-jointed, glazed socket pipes, communicating with a small tank placed in the garden of the house. Into this tank, which may be about eighteen inches deep by twelve inches wide, and of a length in accordance with requirements, the slops are automatically discharged periodically from the flushing tank, as also the surplus rainwater from the roof of the house. From this small tank sewer drains are laid across the garden formed of common three-inch drain pipes, eight feet apart and twelve inches below the surface of the ground, having joints made with mortar at the top and bottom but being left open at the sides. The liquid from the tank will ooze through the sides of the joints of the drain-pipes and penetrate the surrounding soil. By means of this simple plan the slops can be effectively dealt with, and neither smell or poisoning of the atmosphere by foul gases be experienced, whilst the house slops and sink water are turned to profitable account.

It is said that when pipes that had been laid on this plan were taken up for inspection after having been laid for a period of from eight to ten years, very little mud was found, and only in one or two places was the working of the system interfered with where bad laying of the pipes had caused some slight obstruction.

**Privies.**—These are out-door closets used in connection with houses in the country. They are usually very primitive constructions, consisting simply in a seat placed above a privy-pit or cesspit, and the only attempt at deodorising generally made, and that but rarely, is the occasional sprinkling of quicklime over the excrement in the said privy-pit. Every privy should be fitted with a receptacle to hold a supply of ashes, dust, or some other dry refuse, and a charge of this should be sprinkled periodically upon the filth deposited in the pit, either by hand, or by means of some suitable automatic, or other delivery apparatus.

Full instructions regarding the constructions and maintenance of privies will be found in the Model Bye-Laws at the end of this volume.

## CHAPTER XI.

## SLOP-SINKS, AND KITCHEN OR SCULLERY SINKS.

**Slop-Sinks.**—Where a separate slop-sink is provided in large houses for the disposal of the slops from bedrooms, it is a usual plan to take the waste-pipe direct out through a wall to the soil-pipe, the branch-pipe being trapped in a precisely similar manner to that from a water-closet basin. As an alternative arrangement the waste-pipe may be arranged to discharge over a gully-trap, as has already been described, the end of the said waste being fitted with a flap-valve (*see* p. 52).

Slop-sinks are sometimes so constructed that they can be also used as urinals.

As before mentioned, many water-closets (some of which have been described under that heading) are made which are suitable for receiving slops, and one or other of these will be found to be the most convenient and cheapest for use in a house of moderate dimensions, thereby enabling a separate slop-sink or hopper to be dispensed with.

Figs. 56 and 57 show two forms of household slop-sinks made by Messrs. J. Tylor and Sons, Limited, London. That illustrated in Fig. 56 has an earthenware basin and trap, the latter being provided with a socket to receive a ventilating or anti-syphonage pipe. The basin is fitted with a removable perforated bottom plate, which can be readily taken out for cleansing purposes, and the top has a high skirting to prevent splashing over the sides and back. The service or supply pipe is fitted with a flushing-tap and with a rinsing-tap, or tap from which water can be drawn off for domestic use.

The basin and trap are usually enclosed by a casing having a large door for admitting of access to the interior for cleansing or repairing purposes, as shown by dotted lines in the drawing.

Fig. 57 shows a slop-sink, having an enamelled iron basin and trap. The basin is fitted with a brass cobweb grating, and the trap has a large cleaning or inspection cover. These slop-sinks are intended to be fixed in a similar manner to water-closets, and require three-inch waste or branch pipes. The traps can be formed to shoot out if required.

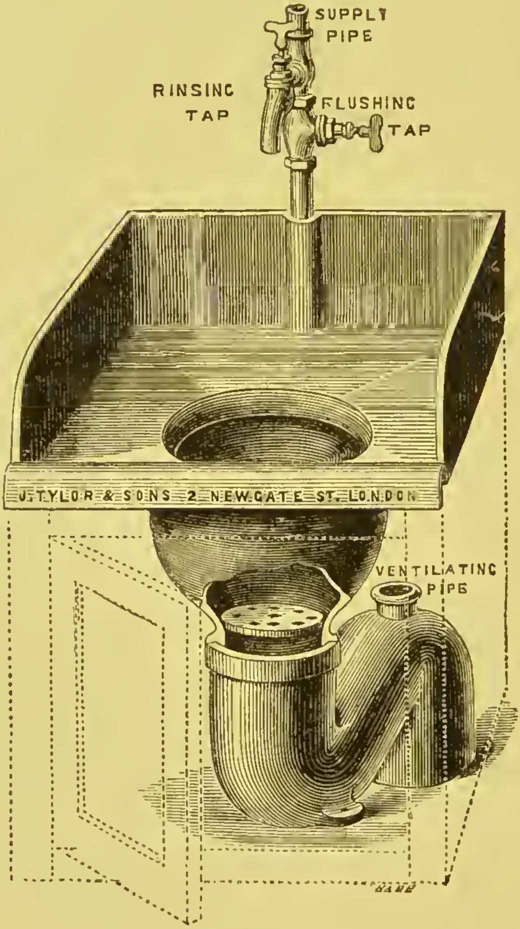


Fig. 56.

**Scullery or Kitchen Sinks.**—Scullery or kitchen sinks are usually made of stone, lead, enamelled iron, or of hard glazed stoneware. Those made of enamelled iron, and of strong, hard, well-glazed stoneware, are preferable, being most easily kept clean.

The waste-pipe from a sink should be completely detached from the drain, and arranged to discharge in the open air above the grating of a gully-trap.

It is not uncommon to find kitchen or scullery sinks connected directly with the drains and fitted with bell-traps. These traps should not be employed, as the bell is liable to be left off, thus rendering the trap useless. A properly constructed lead or brass trap, having an easy sweep and no corners or surfaces liable to catch or retain sediment or silt, and a screw-plate for removal for cleansing and clearing purposes should be used, and where a bell-trap is found a substitution should be made at once.

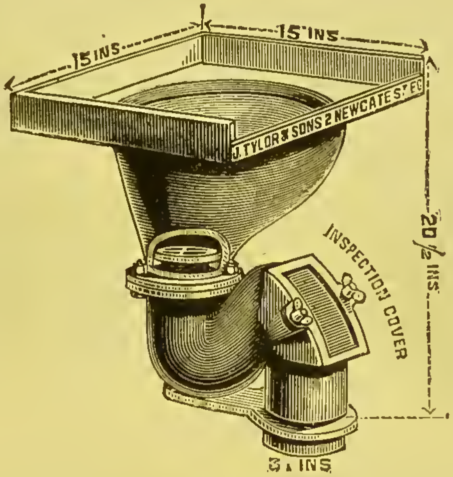


Fig. 57.

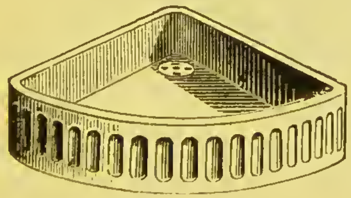


Fig. 58.

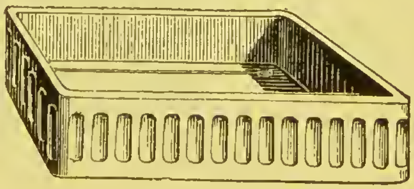


Fig. 59.

Figs. 58 and 59 show respectively an angular and a rectangular kitchen or scullery sink made of enamelled or hard glazed stoneware, designed and made by Messrs. J. Tylor and Sons, Limited, London.

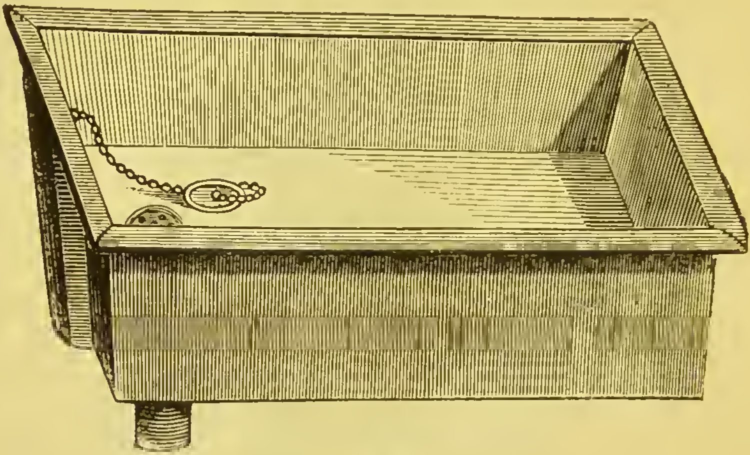


Fig. 60.

Fig. 60 is a deep cast-iron enamelled butler's or pantry sink made by Messrs. John Bolding and Sons, London.

# CHAPTER XII.

## GULLY-TRAPS.

GULLY-TRAPS, for receiving the discharge from sinks, baths, &c., and also the rain and surface water, are made of stoneware or cast-iron ; if of the latter material they should be either galvanised or coated with Dr. Angus Smith's or some equivalent composition for preventing corrosion.

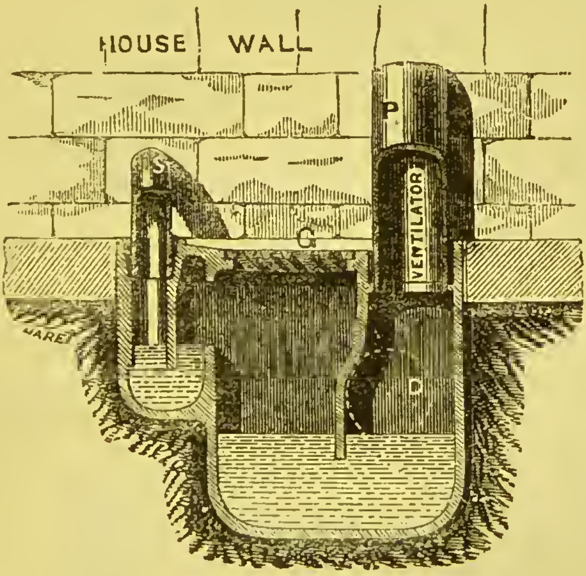


Fig. 60A.

A gully-trap should be so constructed as to effectually clear itself with the general amount of flushing effected by the waste water from a dwelling-house. A gully-trap should be placed outside a house, and be favourably situated for taking the discharge from the sinks, baths, wastes, &c., and also the surface-water.

Mansergh's Patent Combined Sink, Yard, and House-Drain Ventilating-Trap (Fig. 60A) is fitted with a grating G that can be easily removed for clearing the trap of deposit. The waste-pipe is trapped independently of the yard or surface trap. A suitable upcast pipe is provided for ventilating purposes. S is the waste-pipe from the scullery or kitchen sink, D is the house or soil drain, and P is the rain-water or ventilating pipe.

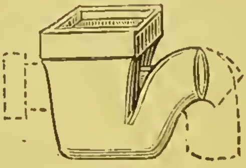


Fig. 61.

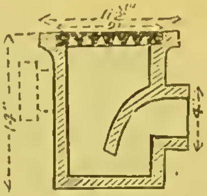


Fig. 62.

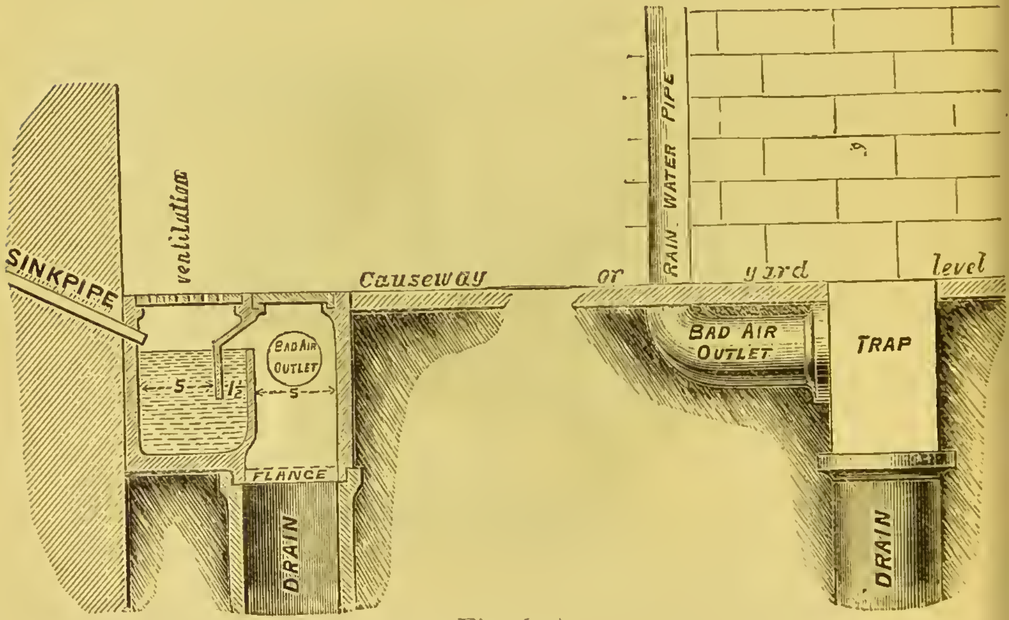


Fig. 63.

In some instances the trap is employed as a rain-water shoe, the rain-pipe acting also as a ventilating pipe. In this case, great care must be exercised to see that the point of discharge is well removed from any attic or other window, and is not so placed as to admit of any foul gases escaping therefrom, gaining access to the interior of the house through the eaves.

This can only be accomplished with safety by carrying the rain-water pipe or fall-spout well above the eaves trough, and connecting it with the latter through a suitable trap, such for instance as Riley's patent. In this latter arrangement the eaves trough is made to discharge in the open, above a trap formed on, or connected with, the fall-spout at a point below the open upper end. The bore of the fall-spout being considerably larger than that of the outlet from the eaves trough, the said fall-spout does not become fully charged with rain water, the latter running down the sides thereof and leaving a central space constantly open for the free passage of foul air or gases from the drains.

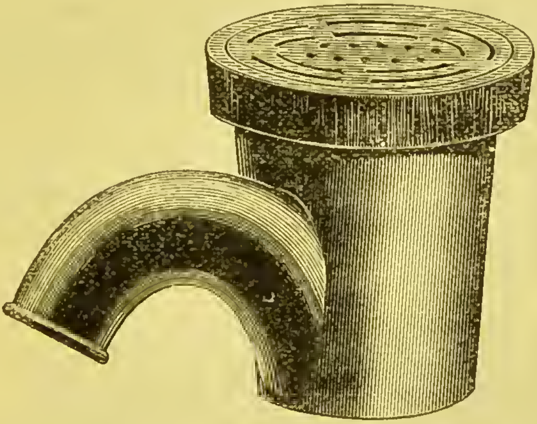


Fig. 64.

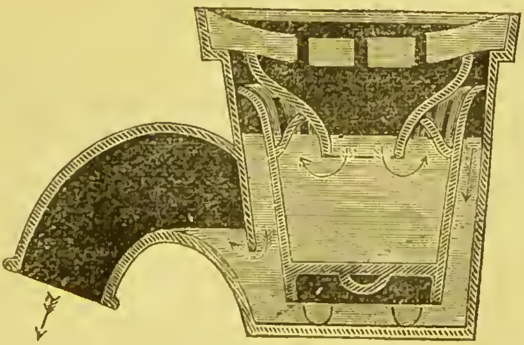


Fig. 65.

Figs. 61 and 62 show two forms of stoneware gully or drain-traps, manufactured by Messrs. George Skey and Company, Limited, Tamworth.

The taper form shown in the perspective view, Fig. 61, has a P trap, and is provided with a dish-cover. It is also made, as shown by the dotted lines, with an S trap and with a side inlet.

Fig. 62 is a vertical central section, showing a rectangular form of gully with a P trap, and fitted with a grid or grating. This trap is also made with a side inlet, as shown by the dotted lines.

Fig. 63 shows two views (front elevation and vertical transverse section) of an arrangement of trap manufactured by Messrs. Oates and Green, Halifax. This trap is designed to be so fixed as to be flush with the line of the causeway or yard-level. The down or waste-pipe from the sink discharges below the cast-iron ventilating grating, which also affords a ready means of gaining access to the interior of the trap for cleansing purposes. A suitable upcast-pipe is likewise provided for ventilation at the drain side of the trap, and an inspection hole or aperture fitted with an air- or gas-tight cap or cover.

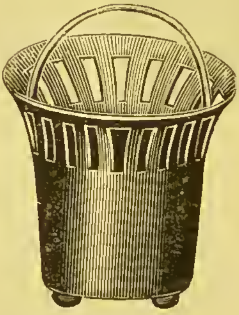


Fig. 66.

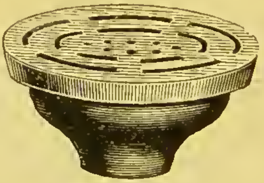


Fig. 67.

Figs. 64 to 68 illustrate an improved form of cast-iron gully or drain-trap, designed and manufactured by Messrs. Goddard Massey and Warner, Nottingham. Fig. 64 is of a circular pattern, and the arrangement of the working parts are clearly shown in the vertical central section, Fig. 65, and in the detail views, Figs. 66 and 67. The hopper is cast in one with the top grate or grid (Fig. 67), thereby reducing the evaporating surface of the water to a minimum, and by dipping below the overflow grating forming the first trap. Surrounding this hopper is a sludge-box (Fig. 66) with a movable handle, which falls back out of the way, and also a second handle cast on the bottom to facilitate the emptying thereof; the perforations shown round the upper edges of this sludge-box, whilst admitting of the free passage of any liquids, effectually prevent the penetration of anything beyond the box which would be likely to conduce to the choking of the drain, and the upper part of the box is so made as to form a second trap, which, however, is only of service for a bottom outlet. When constructed with a side outlet, as shown in the drawing, another or second trap is effected by the curved outlet pipe.

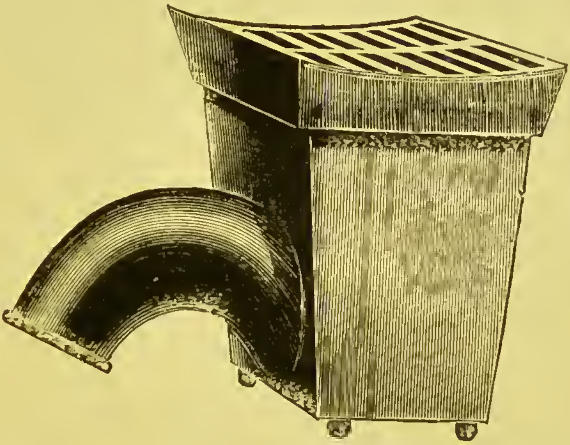


Fig. 68.

Fig. 68 shows a gully or drain-trap of similar construction, but of rectangular pattern.

These gully-traps are coated with Dr. Angus Smith's composition for preventing corrosion.

# CHAPTER XIII.

## INTERCEPTING OR DISCONNECTING TRAPS.

THESE traps, as has been already mentioned, are intended to be interposed between the soil-drain of a house and the public sewer, so as to disconnect and cut it off therefrom, and prevent foul gases generated in the latter from gaining access to the said soil-drain, and thence through defective joints or fittings into the interior of the house. Intercepting or disconnecting traps may be divided into two classes, viz., those which by reason of their shape are practically self-cleansing, and those which are not, but are liable to become choked by accumulations of filth or deposit, and are consequently sure to become a source of trouble and expense sooner or later. It need not be said that the latter description of traps should be studiously avoided.

It is the general practice to form a self-cleansing intercepting trap of an area smaller than that of the drain or pipe discharging into it. It is also well to have a fall of from two to four inches at the inlet side, by which means sufficient power is obtained through the fall of the liquid or cascade to ensure the resistance of the trap being overcome. In some instances certain portions of the trap are formed oval in transverse section.

The inside of the trap should be well finished and perfectly free from any asperities or roughness, and it should be regular and true in form.

Figs. 69 and 70 show two forms of stoneware intercepting or disconnecting traps, manufactured by Messrs. Doulton and Co., Lambeth. That shown in Fig. 69 is designed more especially for use in an inspection or intercepting chamber, and is provided with a half socket for receiving a channel pipe, and with an inspection arm, which can be hermetically closed by means of a plug, lid, or cover.

Fig. 70 shows a ventilating stoneware intercepting trap, which is also provided with an inspection aperture, which can be closed by means of a lid or cover, and furthermore with a vertical socketed arm to receive a ventilating pipe or shaft.

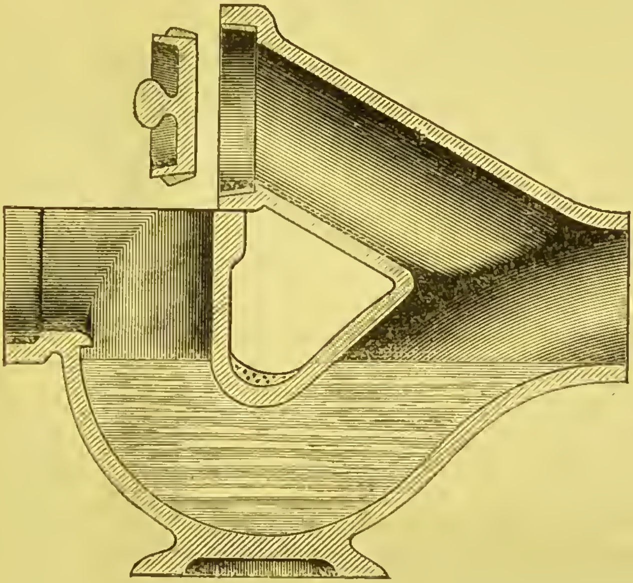


Fig. 69.

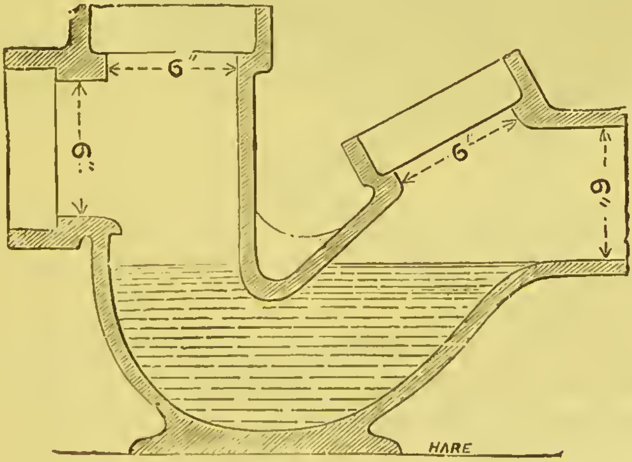


Fig. 70.

Fig. 71 illustrates an application of a patent universal interceptor or disconnector trap, designed by Messrs. J. Tylor and Sons, Limited, London. The trap is shown in the drawing in vertical central section, it has an easy sweep, and is fitted with a connector, and with a shaft or pipe (as indicated at B) for the admission of fresh air.

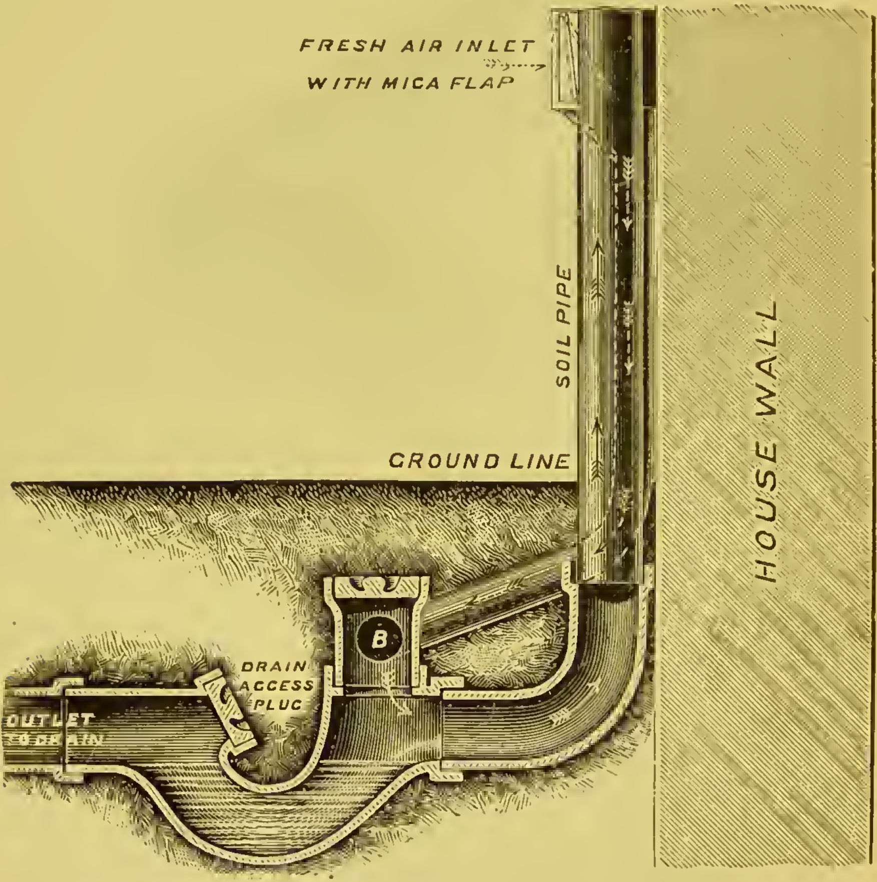


Fig. 71.

By the use of an intercepting or disconnecting trap, such as that illustrated in Fig. 70, or in Fig. 71, an intercepting or inspection chamber is dispensed with.

# CHAPTER XIV.

## BACK-PRESSURE AND TIDAL VALVES.

BACK pressure or outwardly opening valves are applied to the extremities of waste-pipes, in order to prevent the entrance of sewer-gas or foul air, and the passage up them of noxious smells from the traps into or over which they are arranged to discharge, and also to overflow, and to warning pipes to obviate the draughts or currents of air that might otherwise gain access to the interior of the house through them. They are also used in gully-traps, and in connection with drains in the form of flap-valves or ball-valves, to prevent the possibility of a back flow of sewage taking place, in cases where a liability exists to flooding of the public sewers from storm water, or where they discharge into the sea or into a tidal river.

In the first case a brass or copper flap-valve, such as that illustrated in Fig. 72, and made by Messrs. J. Tylor and Sons, Limited, may be used. That shown in the illustration is a brass flap-valve intended for iron pipe, when used for lead pipe it is formed with a shoulder; copper flap-valves are usually only provided with a hinge, having a tang or extension for soldering to the lead pipe.

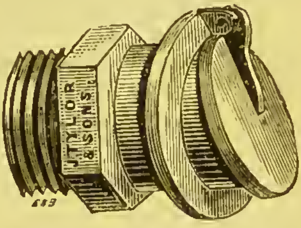


Fig. 72.

There are various other applications of flap-valves, such as glazed stoneware socket and block flap-traps or valves, glazed stoneware yard gully with flap-trap or valve on inlet, glazed stoneware gully for disconnecting sink and urinal wastes, having flap-traps or valves fitted to the inlets. These latter are a great improvement on the ordinary gully-trap, especially in the case of urinals, in which the stirring-up of the stagnant and offensive liquid (usually present in the trap) when flushing, or using the urinal, causes foul odours to pass up the waste; these odours are kept back when the inlet is fitted with a gas-tight flap-trap or valve.

Figs. 73 and 74 show two patterns of gully-traps (Couzens' Patent), made by Messrs. G. and F. Couzens, Cardiff. These gullies are designed not only to form hydraulic traps to prevent the escape of sewer-gas, but also to effectually stop the back flow of tidal or storm water by means of suitable back-pressure valves.

The pattern shown in Fig. 73 is fitted with a pivoted flap-trap, valve, or door, so counterpoised or counterweighted that it remains normally closed (as shown by the full lines in the drawing), but will open (as shown by the dotted lines) to admit of the passage of any liquid through the trap to the drain. The outer shell is made of glazed earthenware. The internal parts are made of iron, with the exception of the weighted lever, which is made of brass to prevent corrosion, and are very readily removable for repairs, renewals, or other purposes. The door has on its upper surface a facing or piece of india-rubber of its full size, and properly secured thereto, thus guaranteeing an effectual trap against the back-pressure of water or sewer-gas. The gully-trap can easily be cleaned out by pressing the door down, as indicated in the dotted lines.

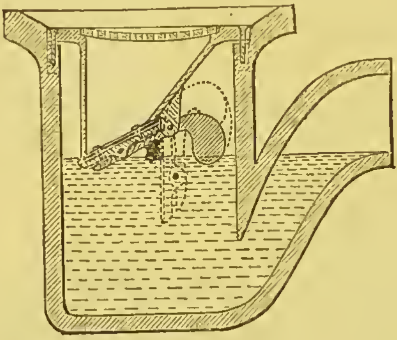


Fig. 73.

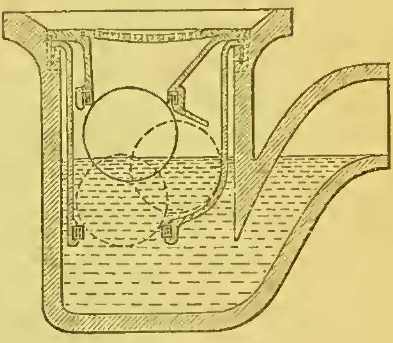


Fig. 74.

Fig. 74 shows an arrangement wherein a ball-valve is substituted for the flap-trap or valve. The ball is formed of copper, and, being hollow, floats upon the surface of the liquid in the gully, as shown in full lines in the drawing.

The action is automatic; when there is any back-pressure of water the said floating copper ball rises and fits tight against an india-rubber seating, which is held in position in a groove in the iron casting which fits down inside the earthenware shell. Should the water evaporate in dry weather, the ball descends and rests on another india-rubber seating (as shown by the dotted lines), thus forming an effectual trap against sewer-gas. The sink can easily be cleaned out by passing the hand down and pressing the ball on one side into the second or middle position also shown in dotted lines in the drawing.

Fig. 74A illustrates a gully-trap having inlets fitted with flap valves, designed and made by Mr. George Jennings, Lambeth. This trap is constructed in two parts, the lower one having an outlet forming a P trap as shown in the drawing, or if preferred one forming an S trap can be provided. The upper part has two or other desired number of inlets, each of which is fitted with a flap valve so suspended as to be slightly out of the perpendicular when against its seating, thereby ensuring the normal closing of the said valves firmly against the latter.

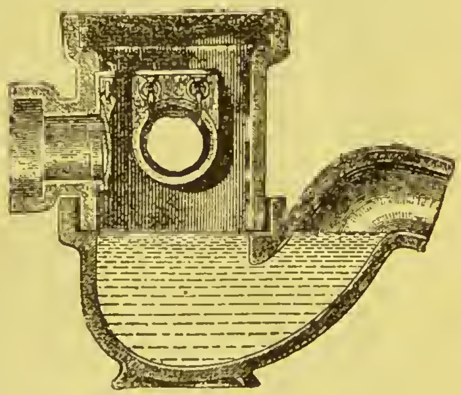


Fig. 74A.

Gully-traps, also constructed in two parts, and fitted with a ball-float valve, have also been designed, and are made by Mr. Jennings.

The formation of the traps in two parts is convenient, inasmuch as it admits of greater facility of adjustment being made when fixing, relatively to the several waste pipes to be connected thereto.

Fig. 75 is a perspective view of an inspection chamber, the side wall being removed and showing partly in section a patent valve designed by Mr. F. Dyer, London, for arresting the back flow of sewage, and the entrance of sea or other waters into places where the sewage discharges into tidal waters. These valves are constructed of large dimensions for fixing at the mouth of main sewers, and also of sizes suitable for use in connection with factories, hotels and private houses. They can be fixed in any convenient part of the drain between the building and the outfall, and can be arranged either for any desired fall, or for a dead level. The copper ball forming the valve is suspended in the valve casing by a pivoted arm or connecting rod, and is constructed of thick copper, and the seating, which is on the inlet side, is of india-rubber and so arranged that when the said ball is pressed against the latter by any backflow into the drain it will close hermetically against the said seating and render the passage of any sewage or water up the main, or the soil-drain, to the dwelling, impossible. The pivoted arm or connecting rod carrying the copper ball or valve is so inclined towards the inlet branch that the sticking of the said ball with the arm in a vertical position, or the liability of its moving in a wrong direction, is rendered practically impossible. The ball readily falls when the back pressure ceases and unseals the inlet.

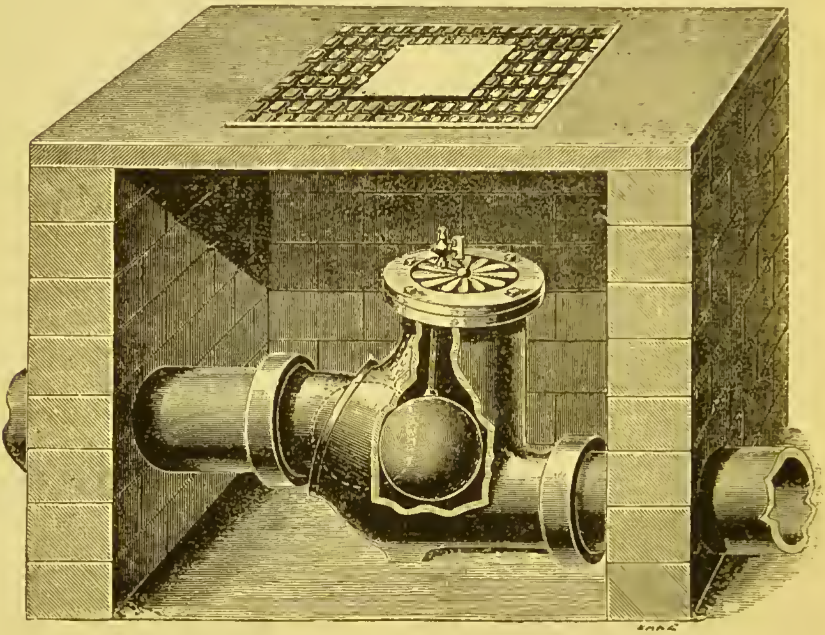


Fig. 75.

# CHAPTER XV.

## GREASE AND FAT-TRAPS.

GREASE-TRAPS are absolutely necessary fittings in large establishments. When a grease-trap is not provided the fat from the sinks will accumulate in the small gully or in the pipe further on, until finally a complete stoppage takes place in the water-way, thereby causing much inconvenience and expense. In a grease-trap the fat is separated by dropping into a comparatively large body of cold water, and, by reason of its lesser specific gravity, floats on the surface in an approximately solid condition, from where it can be periodically broken up and removed by flushing through an automatic flushing tank or cistern, or otherwise. In some grease-traps baffle-plates or obstructions are provided against which the greasy water is driven before the outlet from the trap is gained, thereby accelerating the separation of the fat from the water. In other traps a cast-iron receptacle with a long central handle is arranged in the bottom of the outer casing, which receptacle can be

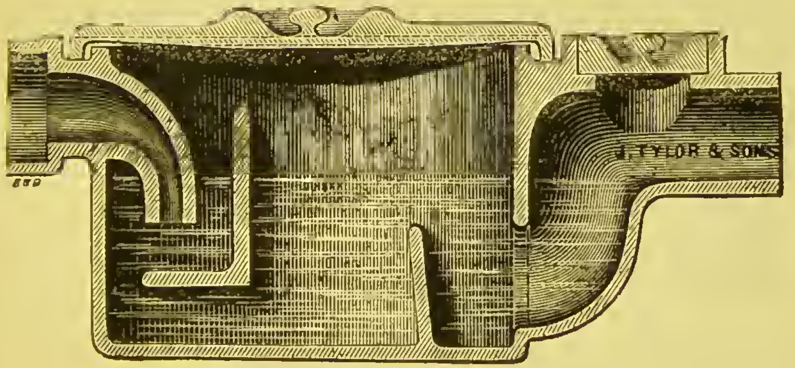


Fig. 76.

occasionally removed, and the silt and other deposit, and the greasy matter, cleaned out.

Fig. 76 illustrates a patent grease and fat-trap, designed by Messrs. J. Tylor and Sons, Limited, London. This trap is constructed of glazed stoneware, the inlet is tapered or reduced, and baffles or obstructions are provided for ensuring the separation of the fatty or greasy matter from the water, as hereinbefore mentioned. A large lid or cover, with means for enabling a tight joint to be formed, is provided for admitting of ready access being obtained to the interior of the trap for cleansing purposes, and also an inspection hole or aperture on the drain side of the trap, which is normally hermetically closed by a suitable lid or cover.

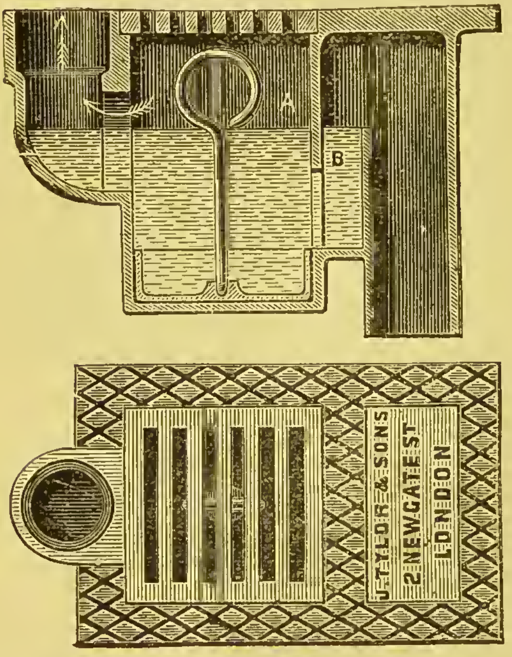


Fig. 77.

The illustration, Fig. 77, shows a galvanised iron grease or fat-trap made by the same firm. This trap has a removable cast-iron grid or grating, and is fitted with a cast-iron dish or receptacle, which can be withdrawn by the long handle A, for cleansing purposes. The water level in the trap is high, giving a deep seal as indicated at B.

Fig. 78 illustrates the old original Deane's Patent (1873) grease trap. This grease and silt trap is made of glazed stoneware or earthenware, and is fitted with a cast-iron receptacle or dish having a rim which rests upon ledges formed in the outer part or casing by constructing the lower portion thereof of a reduced diameter. The internal conformation of the said outer part is such as to prevent any lodgment of solid matter taking place elsewhere than in the receptacle or dish.

Fig. 79 shows Brown's Patent stench, silth, and grease trap, which is an improvement upon the old Deane's Patent Trap.

The outer part is made of hard glazed earthenware or stoneware, and the cast-iron grid or grating and the receptacle or tray and handle are galvanized to prevent corrosion. The main feature of novelty in this trap is the provision of an access hole or aperture to the drain. This access hole is formed oval instead of circular, and thus admits of a cleaning rod being passed through with greater ease. It is fitted with an air- or gas-tight lid or cover.

In Fig. 80 is illustrated a grease or fat-trap, designed by Messrs. Winser and Co., Pimlico. It is shown in the drawing fixed in position and connected with a scullery or kitchen sink, an automatic flushing tank or cistern, and the rain-water down pipe.

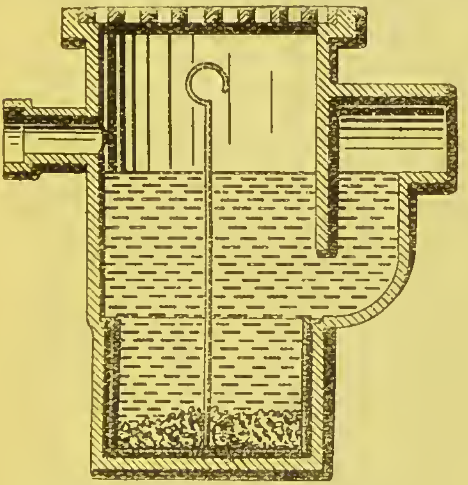


Fig. 78.

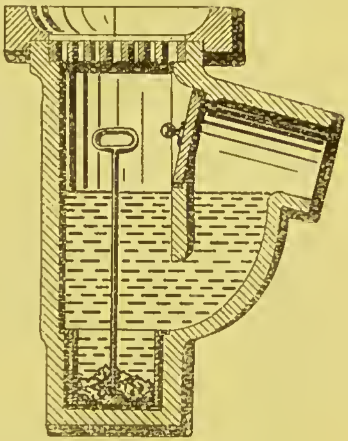


Fig. 79.

The trap is made of glazed stoneware, and is fitted with a cast-iron grating. It is constructed, as will be seen from the illustration, in two parts. The upper part is provided with inlets for branch drains, any of which that may not be required for use being stopped up hermetically by means of a stoneware cap or plug.

The upper portion of the trap is constructed, moreover, with a flushing rim and an arm or socket, by means of which the said flushing rim is connected through a suitable pipe with the automatic flushing tank or cistern. The flushing water being delivered into the trap in an annular stream, through this flushing rim, acts very advantageously upon the cooled grease or fat contained in the said trap, to thoroughly break up or disintegrate it, and carry it into and through the soil drain.

Fig. 81 shows another arrangement of grease or fat trap, connected with a sink, and with an automatic flushing tank, designed by Messrs. Bowes-Scott and Western, of Westminster. The trap also receives the water from the rain-water down pipe, and the bath waste.

The automatic flushing tank is similar in construction to that which will be found described later on under that heading with reference to Fig. 106.

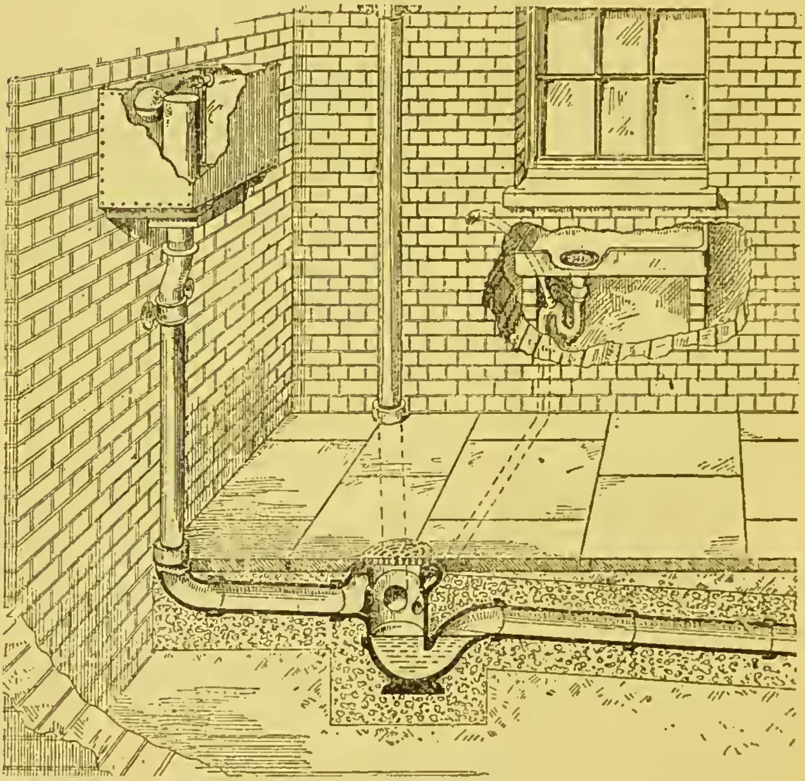


Fig. 80.

The grease trap is formed of stoneware in one piece, and is of large area, thereby presenting an extended water surface to the hot grease discharged into the said trap, and also affording a considerable body of water for it to fall into, whereby the cooling and separation of the said grease is rapidly performed. The cooled and separated grease is broken up and carried away periodically by the flushes from the automatic flushing tank.

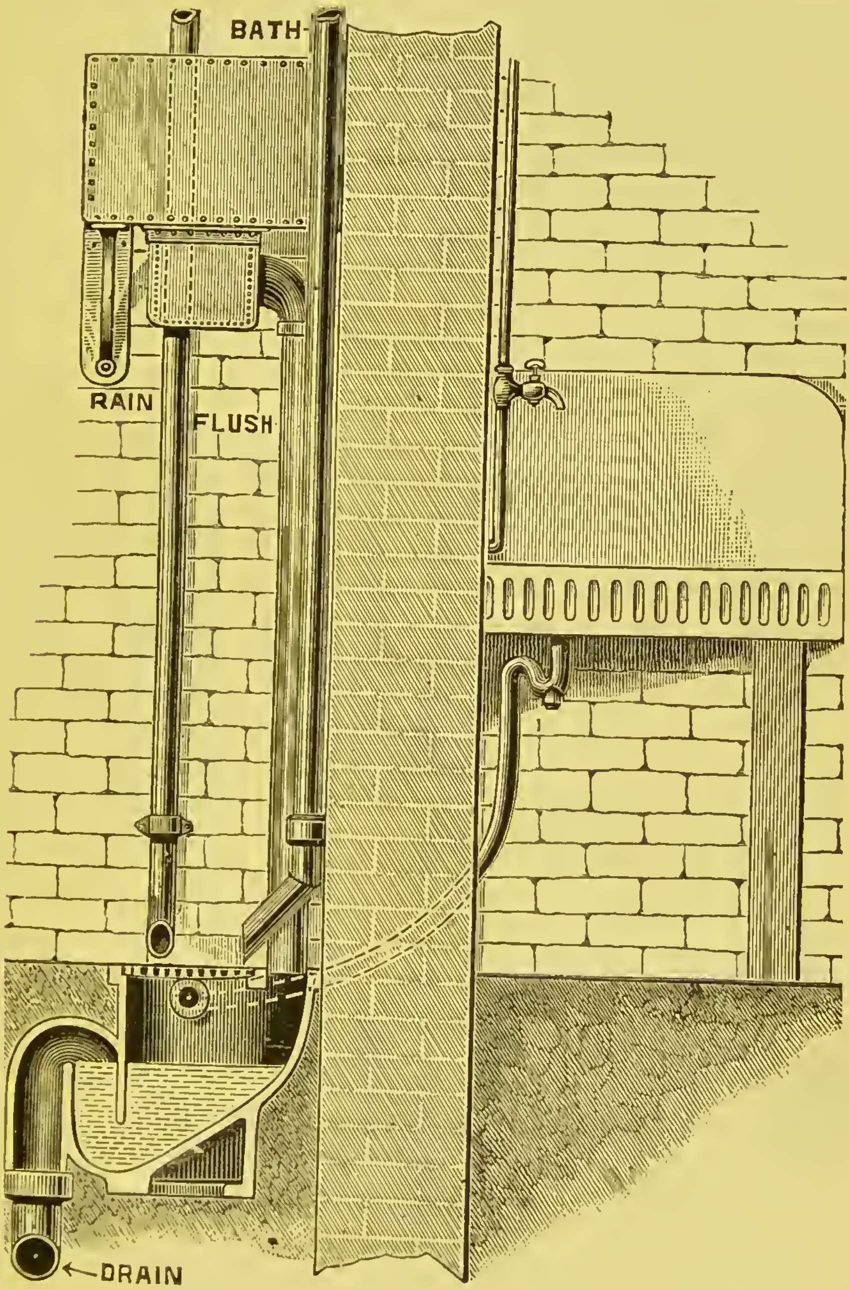


Fig. 81.

In practice this system of dealing with the grease and fat eliminated from the slop or waste water delivered from the waste pipes of sinks, has been found to be very successful, the grease cooling rapidly in the trap, and being broken up and forced through the house or soil drain every time the contents of the automatic flushing cistern or tank are discharged. The length of the periods between each discharge of the said automatic flushing tank or cistern can be regulated to a nicety, by adjusting the supply of water thereto, so as to fill the tank and start the syphon at a longer or shorter interval of time.

# CHAPTER XVI.

## BATHS.

BATHS for private houses are usually made of either cast iron, copper, zinc, porcelain, cast-iron porcelain enamelled, or slate.

The first of these materials is that most generally used for baths as being the cheapest, and if the cast iron be of good quality and properly japan-enamelled, it is good enough for every purpose, and practically indestructible. Wrought copper tinned and enamelled is, however, the best material out of which a bath can be made, and is to be preferred where economy is not an object. For lightness and durability it is quite unequalled, and it is quickly warmed, and does not lower the temperature of water, in the case of warm baths, so quickly as cast iron or porcelain, and it retains the heat for a longer period.

A porcelain bath is extremely clean and pure, and, with care, of great durability, though liable to crack in cold weather, but is heavy and troublesome to move about and fix, and requires a plentiful supply of hot water for heating purposes when a hot bath is required. It is also so excessively smooth of surface as to be extremely slippery, which quality is not unfrequently the cause of accidents to invalids and aged people.

A porcelain-enamelled cast-iron bath affords the advantages of cleanliness offered by one made of porcelain; it has, however, this great disadvantage, that in the event of any accidental damage or fracture to the enamel the injury is likely to increase, and the expense and risk of failure attending the process render its repair by renewal of the enamel practically prohibitive.

Baths made of zinc have the advantages of not absorbing much heat, and of being cheap, but they are short-lived, their bottoms soon getting bulged and bent, and becoming leaky.

Slate baths are, as a rule, undesirable, being very heavy, difficult to fix, and formed with angles and corners which serve to retain dirt, and which render them very troublesome to cleanse.

The waste pipe from a bath should not be connected to a drain or soil pipe, but should deliver over a gully, the end of the said waste pipe terminating at some inches above the grating. The waste pipe should also be trapped, or fitted with a flap-valve, as otherwise should any foul gases escape from the gully they might find their way up the said pipe and gain access to the house.

The bath should stand upon a safe, or catch-all, which consists in a water-tight trough, or tray, of lead or zinc, or other suitable material. This safe prevents any water that might find its way over the upper edge of the bath through splashing, overfilling, or otherwise, from wetting and rotting the flooring, and it should be fitted with a proper waste pipe having at its outer, or free end, a flap-valve to prevent the passage of currents of air to the interior. The necessary precaution of providing a safe is, however, very generally disregarded, even in cases where a bath is fitted up without an overflow, in which case it is, of course, doubly needed.

Water companies object to the fixing of overflow pipes to baths, unless they act also at the same time as warning-pipes. The object being, of course, to prevent the water from running to waste secretly through carelessness. This is in accordance with the regulations made under the Metropolis Water Act, 1871, which provide that—"No bath supplied with water by the Company shall have an overflow waste pipe, except it be so arranged as to act as a 'warning-pipe.'"

It is obviously a highly improper practice to fix a bath without an overflow, or a deep safe or catch-all fitted with a large-bore waste pipe, and one which may lead to serious damage in case the water should be left accidentally turned on.

Figure 82 shows one of the many patterns of baths manufactured by Messrs. J. Tylor and Sons, Limited, London. The bath shown in the illustration is made of metallic enamelled cast iron, and is one well adapted for general use. It is 5 ft. 6 in. in length, and is fitted with hot and cold taps, waste valve, and concealed overflow, and is trapped above the floor level. Or it can be provided with a separate overflow if desired.

Space does not admit of going fully into the subject of baths and the various fittings for same. Some mention, however, must be made of waste valves. It is very desirable that the bath should be fitted with a quick waste valve. Waste valves consisting in a taper plug adapted to fit in a corresponding seating in the bottom of the bath, and pulled up by means of a ring provided thereon, or a piece of cord or chain attached to the said ring, are objectionable for obvious reasons; they have, however, the merit of being simple and cheap. An excellent waste valve is that shown in Fig. 82, and many other patterns are made by the same firm.

Another arrangement of bath waste, designed by Mr. Jennings, consists in a valve worked by means of a lever and rod, by which it can be easily opened. The waste is shut off at the outlet from the bath to prevent dirty water entering the overflow pipe, or any air or other gases circulating or passing through. The conformation of the outlet forming, moreover, an efficient trap, situated above the floor line, and directly beneath the plug, no displacement of stagnant or foul air can possibly take place when the bath is either filled or emptied. The waste pipe may be taken away in any desired direction without passing through the lead safe or floor.

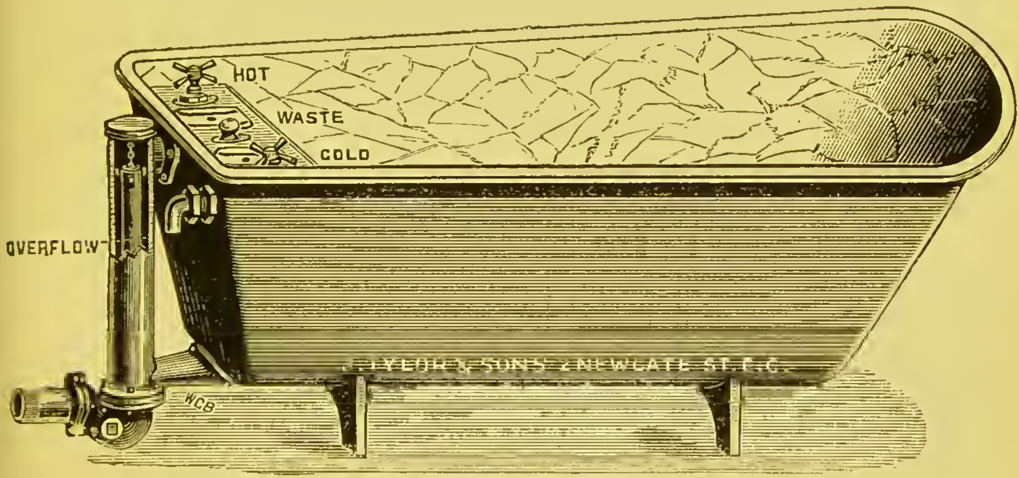


Fig. 82.

# CHAPTER XVII.

## LAVATORIES AND URINALS.

**Lavatories.**—In the smaller classes of dwelling-houses the lavatory, when present, is usually combined with the bath-room, and in some cases with a water-closet. This latter arrangement is both filthy and unsanitary, and should on no account be countenanced. The waste from the lavatory basin should be properly trapped and ventilated, and connected to the soil pipe, as shown in Figs. 17 and 18; or as an alternative arrangement it may discharge in the open above a gully grating, in which latter case the free end should be fitted with a flap-valve.

Figs. 83 and 84 represent two forms of lavatories made by Messrs. J. Tylor and Sons, Limited, London. That depicted in

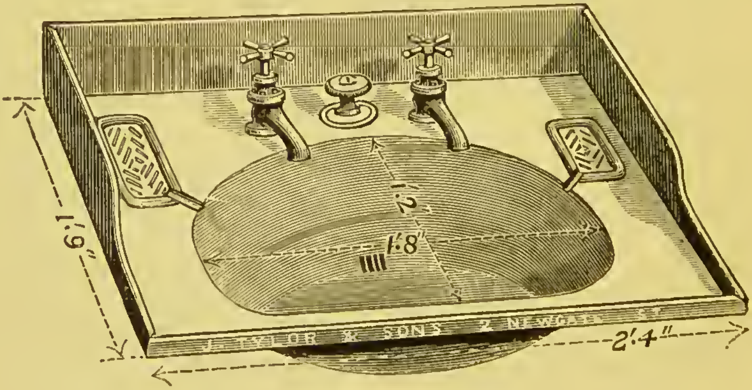


Fig. 83.

Fig. 83 is one of their many patterns of registered designs of cabinet stand tops or lavatory basins, made of ivory china. It is provided with a plain skirting, soap and brush trays suitably drained, and is fitted with two supply valves and a quick waste valve, with pull-up and concealed overflow. The valves and waste are ready fixed to the lavatory, so that it is only necessary to connect the pipes to them. The objectionable taper plug and chain, and the metal grating which becomes tarnished and requires constant cleaning, are dispensed with.

Fig. 84 illustrates an improved form of patent "tip-up" lavatory basin. The tip-up lavatory basin is one of the most convenient forms in use. Those of the ordinary pattern, however, are liable to become foul from the soapy water trickling down the basin, when overflowing, and splashing against it and the receiver, when the basin is being emptied. To remedy this evil, frequent washing or cleansing out has to be resorted to. In the improved form of tip-up lavatory basin shown in Fig. 84, however, this defect is overcome by providing, in the basin, a weir over which the water from the basin, when the latter is tipped up, can be discharged directly into the waste pipe, thereby preventing the receiver and the underside of the basin from becoming offensive owing to the dirty water trickling or splashing against them, as in the ordinary pattern. The said weir forms, besides, an efficient overflow, and any excess of water that may pass over it falls directly into the waste pipe (as shown in the drawing) without trickling down the basin or receiver. It is not necessary to lift the basin so high when emptying, as in the ordinary pattern of tip-up basin.

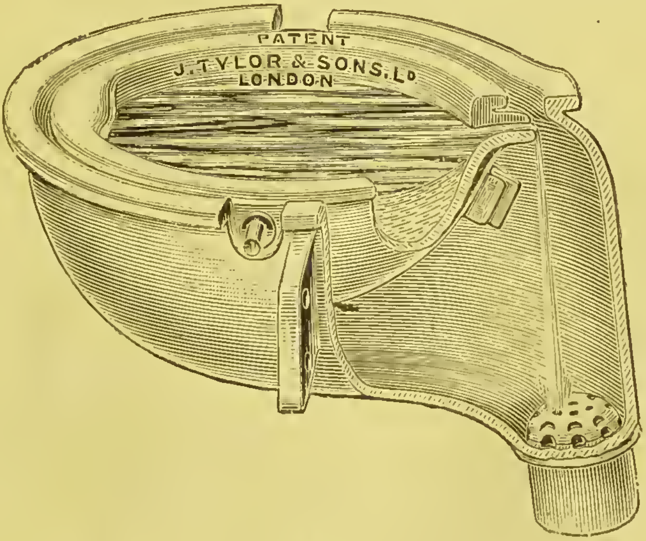


Fig. 84.

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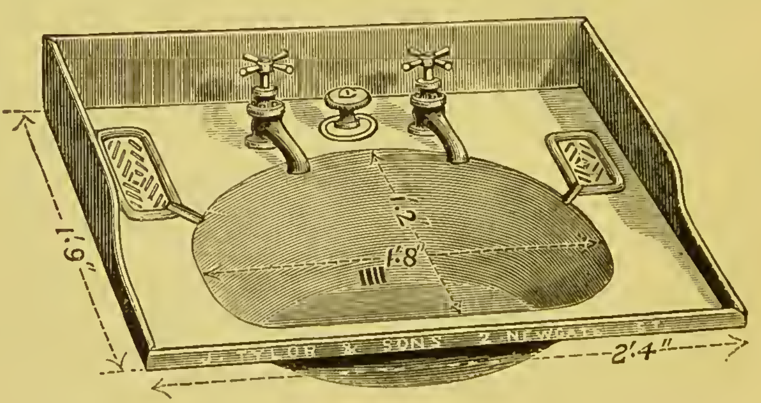

Fig. 83.

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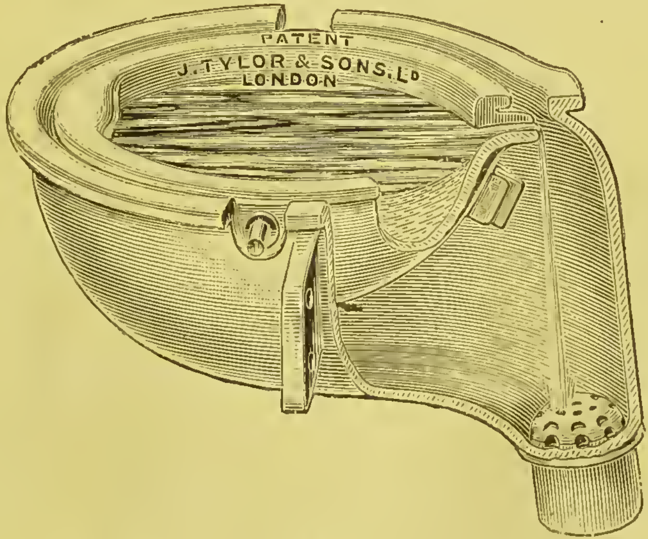

Fig. 84.

**Urinals.**—A very usual and most convenient kind of urinal for private houses is that formed by a water-closet fitted with a urinal top. This arrangement meets all the requirements of a small private dwelling-house.

When a separate urinal is provided in larger houses, it should be placed either in a special chamber, or in the lavatory; or in one of the water-closets, and the waste or discharge pipe should be properly trapped and taken out through the wall and connected to the soil pipe in a similar manner to that of the slop-sink or hopper (p. 93), or of the lavatory basins shown in

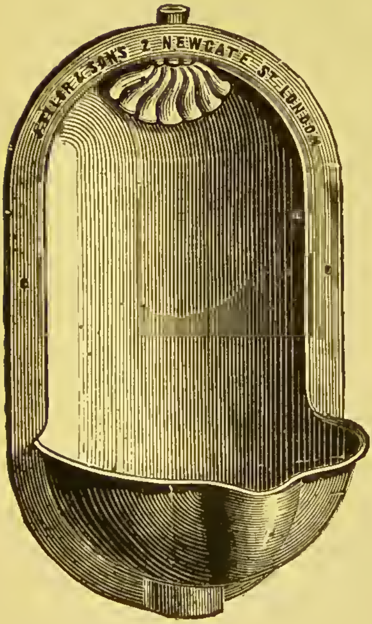
J. TYLOR & SONS 2 NEWGATE ST. LONDON

Fig. 85.

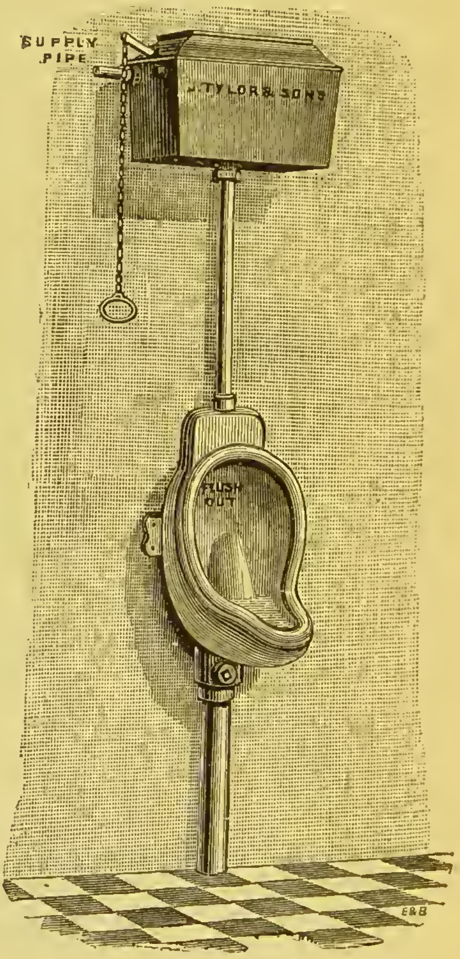

Fig. 86.

Figs. 17 and 18; or it may be connected to the socketed inlet arm of a special gully trap such as that illustrated in Fig. 74A.

Urinals are made in an almost endless variety of patterns, adapted to meet varying requirements. For placing in a water-closet or lavatory in a private dwelling-house, a cradle urinal, either flat-backed or angular, is the most suitable form—the former for placing against a side wall, and the latter for fixing in a corner.

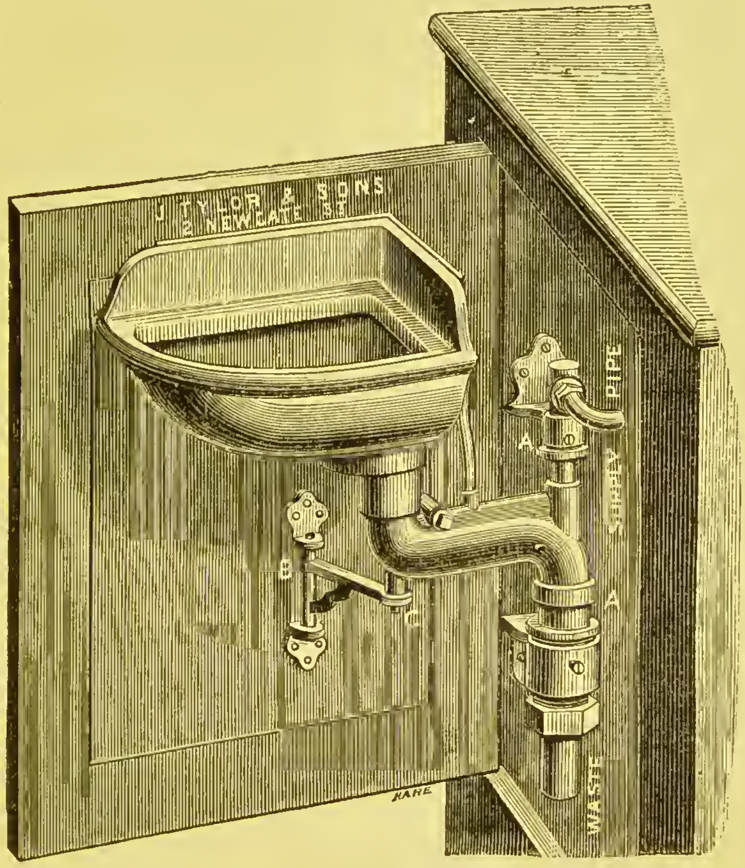

Fig. 87.

Figs. 85, 86, and 87 show three types of urinals designed and made by Messrs. J. Tylor and Sons, Limited, London.

That illustrated in Fig. 85 is a flat-backed cradle urinal. These urinals are made in white earthenware, or in enamelled iron.

Fig. 86 shows a flat-backed flush-out syphon urinal basin, with sealing chamber. That portion of the basin through which the discharge takes place is placed at a higher level than the bottom of the basin, a sufficient body of water being thus retained to cover the basin-bottom to a depth of a couple of inches. On a discharge of water taking place into the basin of the urinal, the syphon is set in action, and the contents of the said basin are completely emptied, the contents of the sealing-chamber covering and sealing the outlet orifice, and preventing any escape of foul air or gases. The urinal-basin is shown in the drawing fixed against a wall ready for use, and connected with a one-gallon valveless, syphonic, water-waste preventing cistern, substantially similar in construction to that illustrated in Fig. 93.

The type of urinal illustrated in Fig. 87 is adapted for use in water-closets, and is also especially admirably suited for bath-rooms, lavatories, billiard-rooms, &c. It is, as will be readily seen by glancing at the drawing, of a cabinet pattern, that is, the urinal basin is so arranged that it is enclosed by, and can be shut up in, a suitable casing and concealed from view when not in use. In this instance it has a patented concealed door-action, and is a self-cleansing urinal. The urinal-basin is attached to the door, and the action of swinging-out or opening the latter also opens both the water supply and waste valves (as indicated at A, A, and B, C, in the drawing), consequently the basin is completely flushed all the time it is in use.

# CHAPTER XVIII.

## WATER-WASTE PREVENTING CISTERNS.

WATER-WASTE preventers are devices intended to be interposed between the supply pipe, and the down or flushing pipe of water-closets, urinals, and the like. All water-waste preventers must comprise the following essential features, the differences between the various patterns being in the details of construction. These features are:—A small box or cistern constructed to contain a predetermined amount of water sufficient for one flush; an inlet connected to the service pipe or other source of water supply, and governed by a ball cock or valve of some suitable construction, and means whereby the contents of the said box or cistern, but no more, can be discharged when—but not until—it is full, or contains the said predetermined charge.

Any apparatus that can be made to discharge continuously, or before it is full or contains the said predetermined charge, is not a water-waste preventer.

Water-waste preventers are an invention intended primarily to prevent water being used for flushing water-closets or urinals in a wasteful manner, and thereby causing loss to the water companies. They are likewise useful for disconnecting water-closets from a supply-cistern, thereby obviating the necessity of providing a separate cistern for that purpose. If water-waste preventers of the best class and make only were used, and, moreover, were such waste preventers constructed to discharge a sufficient quantity of flushing water to effectually and properly cleanse and clear the closets to which they are connected, there would be no objection to their use from a sanitary point of view; on the contrary, where impossible or inconvenient (on the score of expense or otherwise) to provide a separate cistern for the supply of water-closets, urinals, &c., the latter might (as above-mentioned) be effectually and cheaply cut off from the main storage cistern containing water for domestic use, by the interposition of water-waste preventing cisterns. But unfortunately the water companies of the Metropolis are empowered by the regulations made under the Metropolis Water Act, 1871 (see end of this book) to enforce the use of water-waste preventing cisterns or service boxes arranged to discharge a flush of only *two gallons*, and consequently their use becomes, in many cases, intolerable, obnoxious, and highly unsanitary.

It is not easy to imagine how the gentlemen appointed to inquire into the advisability of these regulations could have arrived at the conclusion that a flush of two gallons would be sufficient to insure the efficient action of a water-closet even of the best and most advanced construction, if the said water-closet be liable to frequent use. However that may have been, it is clear that a two-gallon flush is totally inadequate in the latter case, as anyone who has had experience of a closet used under these conditions, by a number of persons in succession, can testify.

The general consensus of opinion amongst manufacturers is that the very least quantity of water that should be discharged at each flush to properly cleanse a well-made and scientifically-designed water-closet is three gallons. The time occupied in delivering this flush should not exceed five seconds. This latter quality is of importance when selecting a water-waste preventing cistern : some of the two-gallon cisterns occupy as much as twelve to fifteen seconds, and even longer, in discharging their contents, and, if a comparatively small body of water is to act efficiently, it is clear that it must be discharged as rapidly, and in as compact a body, as possible.

As the result of recent inquiry and agitation, it is probable that there will shortly be further legislation upon this subject, and the maximum flush to be permitted be increased to three gallons.

Water-waste preventing cisterns consist of two distinct kinds or classes, viz., those wherein the discharge or flush is effected by the direct opening of a valve which normally governs or closes an aperture in the cistern communicating with the down or service pipe, or "valve discharge water-waste preventing cisterns" ; and those wherein the discharge or flush is effected by starting a syphon, the short leg of which dips into the cistern, and extends to within a short distance from the bottom thereof, and the long leg whereof is connected to the down, or service pipe, or "syphonic discharge water-waste preventing-cisterns." Both these classes of cisterns can be further subdivided, and are made in a great variety of different patterns, and in some cases fitted with more or less complicated improvements, most of which are patented. The cisterns are arranged either to discharge the whole of their contents at once, or, when intended for use with valve closets or with syphonic closets, to first discharge the greater portion of their contents, so as to form a main flush, and subsequently to discharge the remainder, or a smaller portion of their contents, so as to form a secondary, or after-flush, for charging the basin of the valve closet, and the trap of the syphonic closet.

The number of different patterns of water-waste preventers now sold is legion; those illustrated and described at the end of this chapter show a few of the types in most general use.

**Fixing.**—The down or fall pipe from a water-waste preventing cistern, fixed for the discharge of water into the pan or basin of any water-closet, must have, according to the Act above referred to, an internal diameter of not less than one inch and a quarter, and if of lead must weigh not less than nine pounds to every lineal yard.

The said down or fall pipe to closet basin should, however, in no case be of a less internal diameter than one inch and a half for cisterns adapted to discharge a flush of two gallons, and from one inch and three-quarters to two inches, for cisterns adapted to discharge a flush of three gallons.

In fixing a water-waste preventing cistern, great care should be taken to avoid any bends or dips in the down or fall pipe, which would form syphons or traps, or that any portion of the said pipe be horizontal, otherwise the efficient action of the cistern will be destroyed. All fall or down pipes should have a straight fall of at least three feet. On the left-hand side of the diagram, Fig. 88, is shown the proper method of connecting the fall or down pipe to the basin. Where an additional bend is absolutely necessary it should be made as easy or slow as possible, all quick or sharp bends being more or less detrimental, the arrangement shown in the centre of the diagram indicates the proper method to pursue in this case. On no account must the bends dip below the dotted lines marked A, as, if they do so as shown at BB, on the right-hand side of the diagram, syphons or traps will be formed, and in the case of a syphonic cistern the action of the main syphon will be destroyed, and the cistern will not work, whilst in a valve cistern the force of the flush will be impeded and its useful effect impaired by the body of dead water to be displaced in these traps.

The overflow pipe from a syphonic water-waste preventing cistern should never be taken into the down or fall pipe, as, if this should be the case, and an overflow take place, the syphonic action would be set up and the cistern emptied.

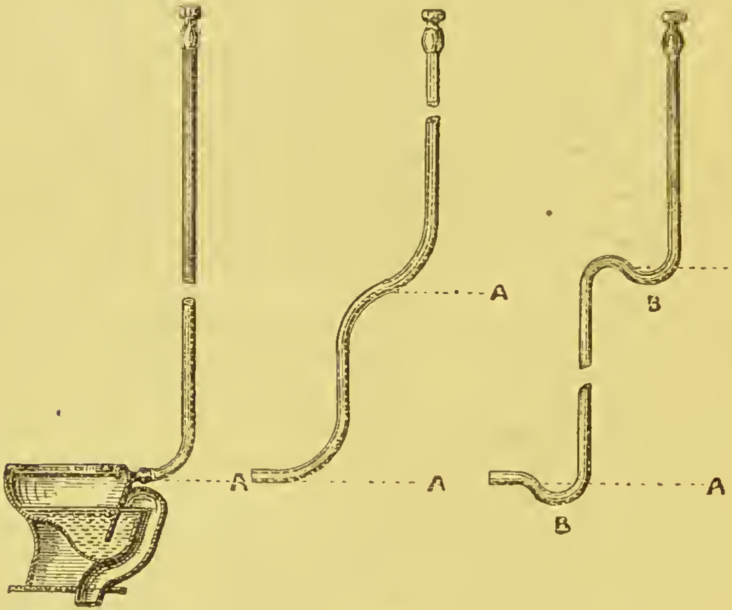

Fig. 88.

**Valve Discharge Water-waste Preventing Cisterns.**—These may be further subdivided into two kinds or classes. In the first, or simplest kind, there is but one compartment in the cistern having a flushing valve for opening or closing communication with the latter and with the down pipe, and coupled to the operating lever; the continuous passage of water through the cistern being prevented by an arm or projection, or by a fork, link, or rod so arranged in connection with the main or operating lever, and the ball-cock arm or lever, that when the said main lever is operated to open the discharge or flushing valve, it will engage with and retain in position the said ball-cock arm or lever, and prevent the delivery of any water into the cistern.

In the second, and more effective class, there are two compartments, in one of which compartments is arranged the ball-cock or valve, and in the other, or flushing chamber or compartment, the main or flushing valve. Communication is established between these two chambers or compartments by means of a smaller valve, so coupled or connected to the main valve-operating lever, that when the latter is operated to open the said main or flushing valve, the second or smaller valve will be closed, and the water trapped or retained in the said ball-cock chamber or compartment. Water-waste preventers of this latter kind or class are usually known as "double-valve cisterns." They are sometimes so constructed as to give a second or supplementary flush, in which case they are called "retained after-flush cisterns."

Valve discharge water-waste preventing cisterns of the first description have no merit as water-waste preventers but that of cheapness. They certainly effectually cut off a water-closet, or urinal basin from the main tank or water supply, but as they are not passed by the water companies, for obvious reasons, and are besides extremely elementary in construction, they will be passed by without an illustration. The essential differences between the various patterns are in the construction of the flushing valves.

**Double-Valve Cisterns.**—In Figs. 89 and 90 are illustrated two double-valve cisterns, designed and made by Messrs. J. Tylor and Sons, Limited, London.

The pattern shown in Fig. 89 has the box or cistern divided into two compartments by a vertical partition. A, A, are two valves, one of which is situated in the flushing compartment and forms the main or discharge valve; and the other, or smaller valve, communicating between the latter compartment, and the other or second compartment containing the ball-cock or valve and float, and opening or closing communication between the said two compartments. The main or discharge valve and the latter valve are coupled, by means of suitable connecting rods, to an operating lever pivoted to the aforementioned partition, and having at its inner end a heavy counterweight, and at the other, or outer extremity, a chain and pull-piece. The above-mentioned valves are so arranged that, under normal conditions, the main or discharge valve is closed, and the second or smaller valve communicating between the two compartments is open. On depressing, however, the outer end of the operating lever through the chain and pull-piece, and thereby raising the inner end thereof, the said discharge or main valve will be opened, and the water contained in that compartment liberated for flushing purposes, whilst the second, or communication valve, will be closed, and the water contained in the second or ball-cock compartment be trapped or retained therein. When, on the completion of the discharge, the pull-piece (which must be held down till the flush is finished) is released, the lever, owing to the counterweight, resumes its normal position, and the main, or discharge valve, being closed, the second, or communication valve, is again opened, and the water retained in the ball-cock or valve compartment passing into the other or second compartment, the float falls and permits the said ball-cock or valve to open, and a fresh supply of water to be delivered through the said valve until the water resumes its normal level in both compartments, when the said float rises and the supply to the cistern is cut off in the usual manner.

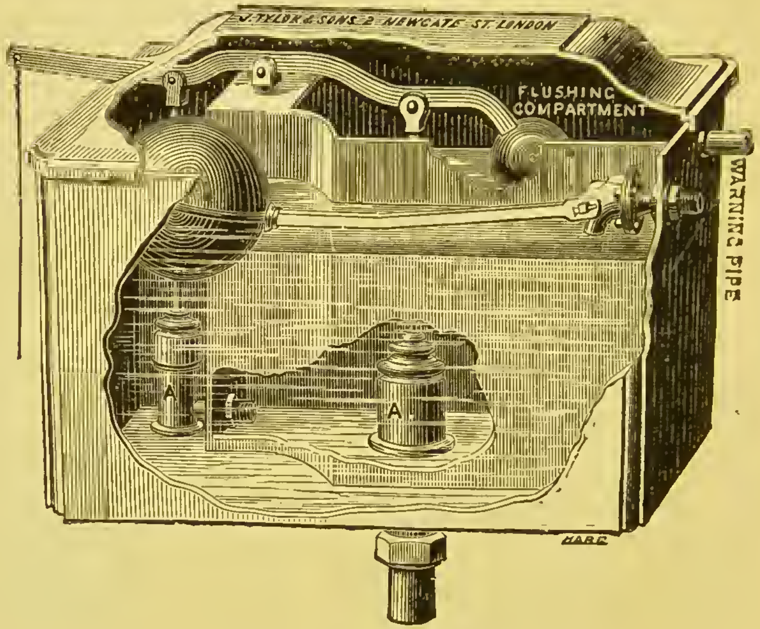

Fig. 89.

Fig. 90 shows a double-valve cistern of the kind or class commonly known as a "retained after-flush cistern" and which is intended principally for use with valve closets. The box or cistern is divided, in this case, into two compartments by an horizontal partition, and is provided on its underside with a well, or pocket, to which is connected the down or flush pipe. The upper or main chamber or compartment is of far larger dimensions than the lower one, and is carried down in one corner to the bottom of the cistern, and in the recess thus formed is arranged the main or discharge valve, which communicates with the above-mentioned well or pocket on the underside of the cistern, and through the latter with the fall or down pipe to the closet. In the said upper compartment, moreover, is also provided a valve for opening or closing communication with the lower compartment, and in the latter a valve communicating with the said well or pocket on the underside of the cistern, and forming the after-flush valve. The latter valve is

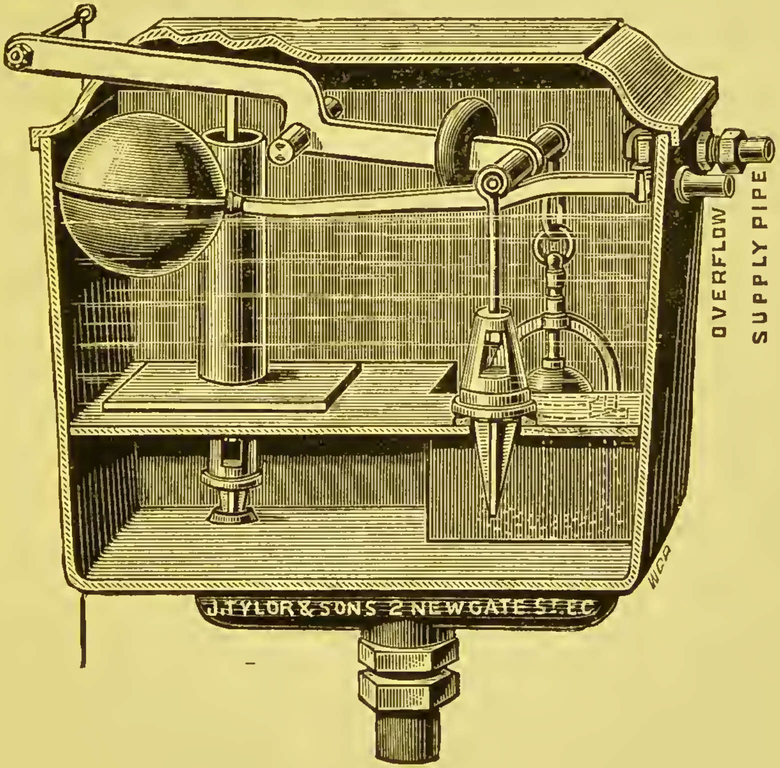

Fig. 90.

coupled through a connecting rod passing through a tube or sleeve secured to the horizontal partition, and extending vertically to a height well above the normal water line, to one end of a lever pivoted to the box or cistern, and to the inner and weighted end whereof are also coupled or connected the main or discharge valve, and the valve communicating between the two compartments. The two latter valves are so arranged as to be normally closed whilst the first-named valve is open. Upon actuating the operating lever, however, the main or discharge valve, and the valve communicating with the lower chamber or after-flush compartment are opened, and the valve communicating between the latter and the well is closed. By this means the water from the upper compartment is permitted to pass to the down or flush-pipe, and the lower chamber or compartment is likewise filled, the water being trapped or retained therein by the closing of the valve communicating with the well of the cistern. On the release of the actuating lever it resumes its normal position, and closing the valves in the upper or main, or large compartment, opens that in the lower or smaller compartment, and permits the water therein to pass to the down pipe and form an after-flush. The main compartment is then refilled through the ball-cock or valve in the usual manner. It is obvious that the outer end of the lever must be held down whilst the main flush is taking place. To prevent the loss of water that might otherwise occur should the said lever be held down after the main flush is finished, a patent main or discharge valve, known as Tylor's Model Waste-not cistern valve, is employed. This valve is so constructed that it cannot be left running, and closes of itself after having let the proper quantity of water pass by. These valves are also adapted for use in lead-lined, galvanised iron and other cisterns, and dispense with the necessity of water-waste preventing cisterns being interposed to regulate the supply of water to water-closets flushed from the said main cistern, in cases where the saving of waste is the object in view.

Valve discharge retained after-flush cisterns, when not fitted with a discharge valve of this description, must, in order to be water-waste preventers, be provided with a third compartment to contain the ball-cock or valve and float, thereby necessitating a far more complicated arrangement of levers and valves.

Valve cisterns are objected to by many water companies on account of the possibility of the discharge valves becoming leaky, through neglecting to renew the india-rubber or other washers, when they become worn out or hard, or through grit or dirt upon the valve seatings, or by reason of the valves sticking or not landing fairly thereon, or from other causes.

Some few companies, however, permit the use of a double valve cistern fitted with alternating valves, arranged in a cistern having two compartments, as above described, so as to let down at each pull only the water contained in one division or compartment, and so that water cannot flow into and out of the compartment at the same time.

**Syphonic Discharge Water-waste Preventing Cisterns.**—These may be further subdivided into three distinct kinds or classes, viz.—1st, those wherein the action of the syphon is set up by opening a valve to admit water to the long leg of the said syphon, or "valve started syphonic water-waste preventing cisterns." 2nd. Those wherein the water is forced up the short leg of the syphon by a piston, plunger, or other displacer, so as to glut the long leg and start the syphon, or "valveless displacer-started syphonic water-waste preventing cisterns." 3rd. Those wherein syphonic action is set up by relieving the air pressure or forming a partial vacuum in the crown or upper part of the syphon, thereby permitting the water to rise under the pressure of the atmosphere in the short leg thereof and pass over into the long leg, or "vacuum-started syphonic water-waste preventing cisterns."

**Valve-Started Syphonic Cisterns.**—Figs. 91 and 92 show two forms of syphonic water-waste preventers wherein the syphons are started by means of valves which communicate with the long legs of the said syphons.

That illustrated in Fig. 91 is designed and made by Messrs. Lee, Howl and Co., Limited, Tipton, and has a cast-iron box and cover, and a heavily weighted valve coupled to the starting or operating lever, and opening or closing communication with the long leg of the syphon. The syphon is made of copper, and is arranged in a well or pocket formed on the bottom of the box or cistern, thereby lowering the line of syphonage so as to completely, or almost completely, empty the latter.

An arm or projection upon the starting lever engages (when the latter is operated to open the starting valve) with the ball-cock arm or lever, and prevents it from falling and admitting water to the cistern should the outer extremity of the said lever be held down after the syphon is started.

Fig. 92 illustrates a valve-started syphonic water-waste preventer, made by Messrs. Winser and Co., London, having a strong dove-tailed wooden box or cistern, lined with lead, with wiped angles. The vertical movement of the valve for admitting water to the long leg of the syphon is insured by arranging the valve spindle to work in a guide firmly secured to

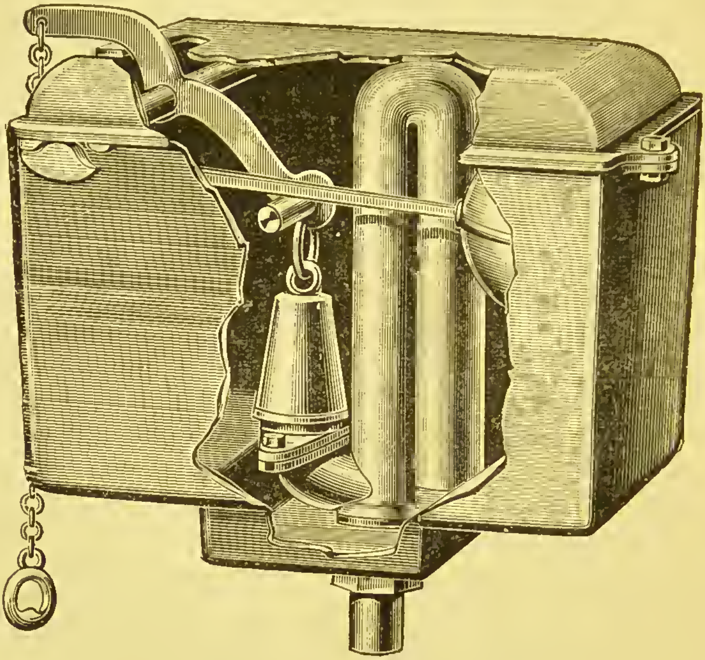

Fig. 91.

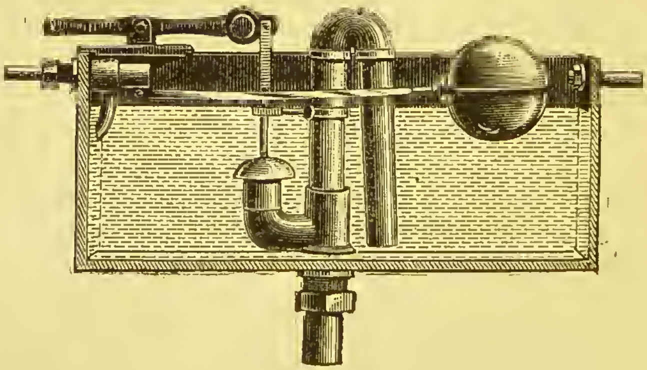

Fig. 92.

the said long leg. The end of the valve spindle is coupled by means of a suitable link or connecting rod to the weighted end of the operating lever, to the other end of which is attached the chain and pull-piece. The starting valve is of the suction class.

By preserving the parallelism of the valve spindle during its to and fro movements in opening and closing the starting valve, the possibility of the latter not landing fairly upon its seating is obviated. Valve-started syphonic water-waste preventing cisterns are naturally liable to the same defects, and are open to the same objections as valve discharge cisterns.

**Displacer-Started Syphonic Cisterns.**—As there are no valves in displacer-started syphonic cisterns except the ball-cocks or valves, they are free from the objection of possible leakages taking place through the down or flush pipes. The normal level of the water in a cistern of this class is usually so regulated by means of the ball or float as to be about an inch or an inch and a quarter below the overflow, and to prevent the syphon from being started automatically to empty the cistern, in case the ball-cock or valve should fail to act in cutting off the supply of water, the said overflow should be placed below the upper extremity of the long leg of the syphon. Figs. 93 to 96 illustrate various forms of displacer-started syphonic water-waste preventing cisterns.

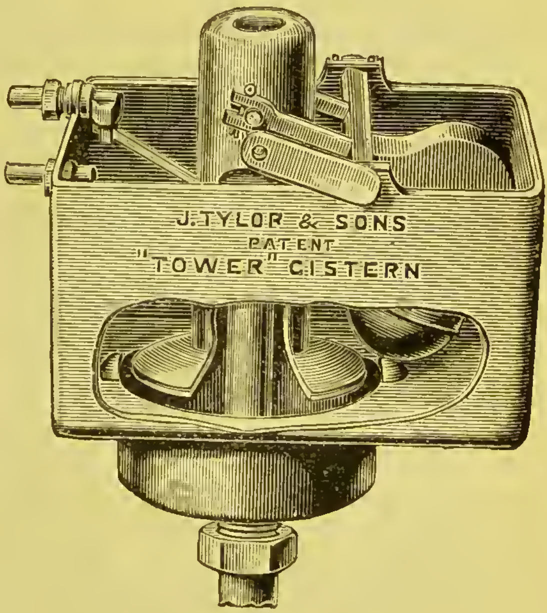

Fig. 93.

In Fig. 93 is shown a patent cistern manufactured by Messrs. Tylor and Sons, wherein a flanged bell or dome-shaped displacer is employed. The flanged portion of this displacer is arranged to work in a cylindrical well, formed on the bottom of the cast-iron box or cistern.

In this case, the dome or displacer is supported by forked levers or arms upon a spindle pivoted to the sides of the cistern, and is normally retained in a raised or elevated position by means of a suitable counterweight. When the said dome or displacer is suddenly depressed into the well (by means of the operating lever, which is likewise firmly secured to or formed on the above-mentioned pivoted spindle), the water therein is forced upwards and overpasses the upper end of the down pipe or long leg of the syphon and starts the latter.

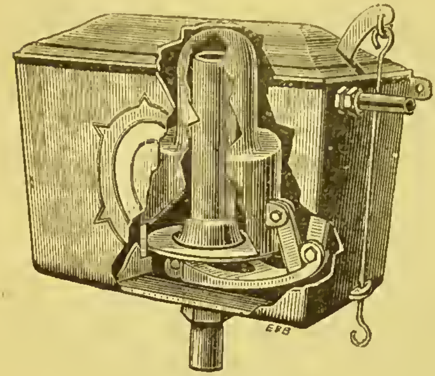
Fig. 94.

Fig. 94 is a valveless syphonic cistern made by Messrs. G. Farmiloe and Sons, London. In this cistern an annular-shaped displacer is so arranged and mounted, that it can be moved in

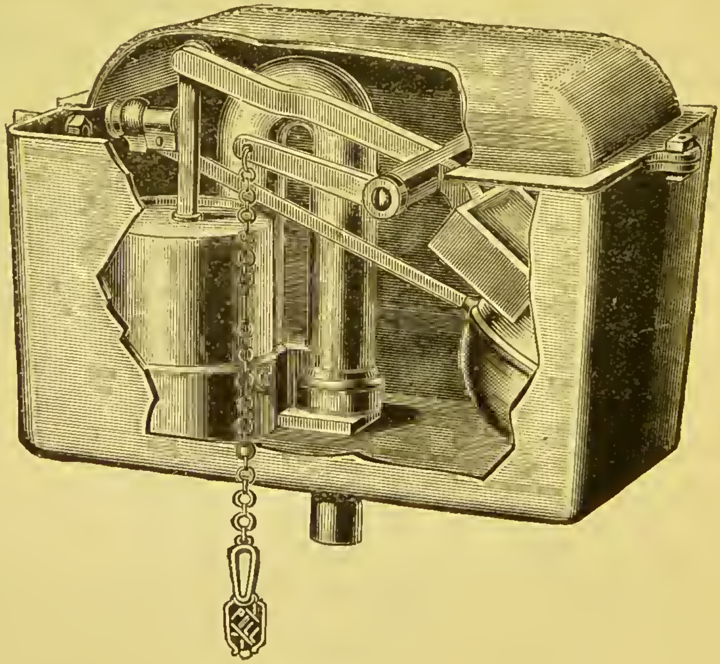
Fig. 95.

an upward direction by a series of levers, in the enlarged cylindrical lower portion of the bell or dome forming the short leg of the syphon, and thus force the water up the said short leg to glut the long leg and start or set up syphonic action.

In Figs. 95 and 96 are illustrated two patterns of valveless displacer-started syphonic water-waste preventing cisterns, designed and made by Messrs. Lee, Howl and Co., Limited, Tipton. In that shown in Fig. 95 the arrangement for starting the syphon consists in a drum or cylinder (shown on the left-hand side of the cistern) connected at its lower extremity to the short leg of the syphon, and fitted with a displacer, disc, or piston formed of non-corrosive metal, and coupled or connected by a suitable rod passing through the upper extremity of the said drum or cylinder, to the extremity of an arm or lever formed on or firmly secured to a spindle, pivoted to the sides of the cistern. On this spindle, and extending in an opposite direction, is another arm or lever, having at its free extremity a heavy counterpoise or counterbalance weight, which acts to retain the other arm or lever in its highest position, and consequently the displacer, disc, or piston at the top of its stroke, and in the upper end of the drum or cylinder. Upon rotating the above-mentioned spindle through a certain angle by means of the short crank arm or lever and chain and pull, shown in front of the cistern, the long arm or lever and disc or piston displacer connected therewith are lowered, and the water will be forced downwards in the drum or cylinder,

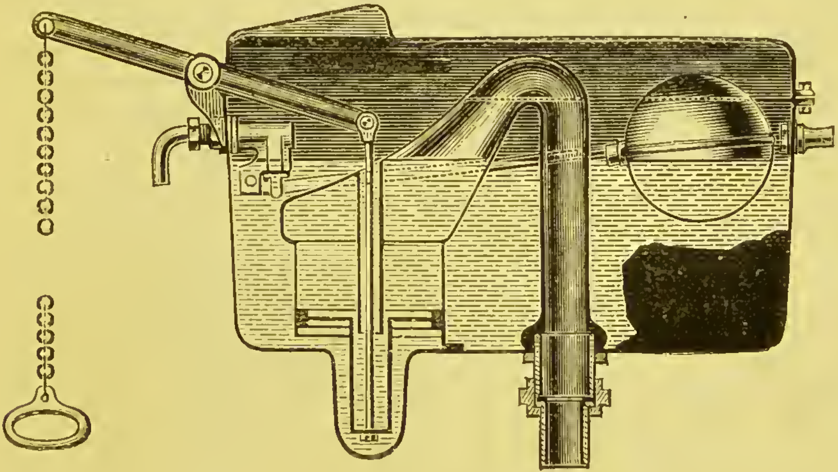

Fig. 96.

and upwards in the short leg of the syphon, thereby starting the action of the latter. The lower part of the drum or cylinder is formed of a larger diameter, thereby providing a clearance, and admitting of the passage of the water up the short leg when the disc or piston is at the bottom of its stroke.

Fig. 96 shows a patent cistern wherein the displacer is formed by a piston coupled by means of a link or connecting-rod to the inner or one end of the operating lever. This piston is arranged to work in the short leg of the syphon, which is enlarged for this purpose. The link or connecting-rod passes through a sleeve secured to the crown of the said enlarged portion of the short leg, which sleeve is received in an annular extension formed on the piston when the latter is raised, thereby doing away with the necessity for employing a stuffing-box and gland, or a bush. The said cylindrical extension upon the piston is received when in its lowermost position in a well or pocket, cast or formed on the bottom or underside of the box or cistern.

This water-waste preventer is especially designed to meet the requirements of the New River Water Company.

A patent valveless displacer-started syphonic cistern, made by Mr. G. Jennings, Lambeth, is illustrated in Fig. 96A. The displacer consists in an annular ring or piston working over the long leg of the syphon and within the bell or dome forming the short leg thereof. This cistern is shown in the drawing so arranged as to deliver its entire contents at each operation. When, however, it is intended for use with a valve, or a syphonic discharge wash or flush-down water-closet, it is adapted to give a first or main flush, and a secondary or after flush. In this latter case the cistern is ormed with a small secondary chamber or compartment. The water for the after-flush is contained in this separate compartment, wherein is also arranged the ball-cock or valve. When the water forming the main or principal flush has been all syphoned out from the main chamber or compartment, there still remains sufficient in the smaller chamber to form the after-flush. In order to effect the discharge of the water from this

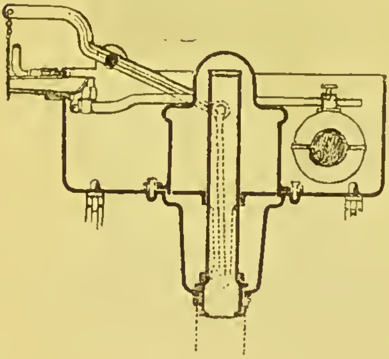

Fig. 96A.

separate compartment it has placed in it the short leg of a smaller syphon, the long leg whereof passes down the long leg of the main syphon for a suitable distance. This smaller or secondary syphon is started by the main syphon, and they both act together for a time, but by reason of the small capacity of the secondary syphon, relatively to the main syphon, it continues to act after the water has been all syphoned out of the principal compartment in the cistern, and the water thus discharged forms the after-flush.

**Vacuum-Started Syphonic Cisterns.**—Figs. 97 to 100 illustrate various patterns of valveless syphonic water-waste

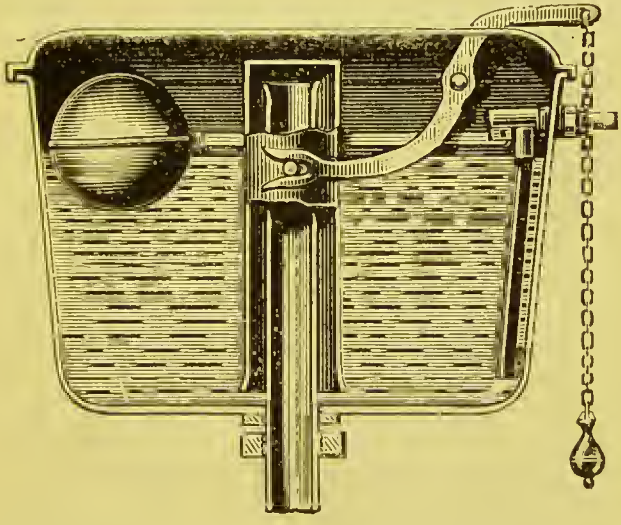

Fig. 97.

preventers, wherein the syphonic action is set up by relieving the air pressure or creating a partial vacuum in the top or crown of the syphon.

In Figs. 97 to 99 are shown three patent cisterns the invention of Mr. Milton Syer, Peckham. In Fig. 97 the short leg of the syphon is formed by a bell or dome, which is connected by means of trunnions or gudgeons formed thereon to the forked end of the operating lever, and is so supported or suspended thereby as to be concentric with the long leg of the syphon, which projects for a suitable distance vertically into the cistern. By raising this dome or bell through the operating lever the pressure of air in the top or crown of the syphon is relieved, and the water level rises until it overpasses the upper end of the long leg, when it flows down the latter and sets up syphonic action. As soon as the syphon is started the operating lever must be released, and the bell or dome permitted to resume its normal position, otherwise the water will not be syphoned completely out of the cistern.

This cistern requires a flap, or other suitable valve, to be fitted to the foot or lower end of the down pipe to prevent air from passing up the latter when the bell or dome is raised, and thus preventing the requisite vacuum being formed therein.

The necessity for a foot-valve on the lower end of the down pipe is dispensed with in the water-waste preventer, shown in Fig. 98, by constructing the bell or dome in the form of a double cap, and thus forming a water-seal in the cistern itself. These cisterns are silent in action, and give a very good flush, the power of which increases towards its termination.

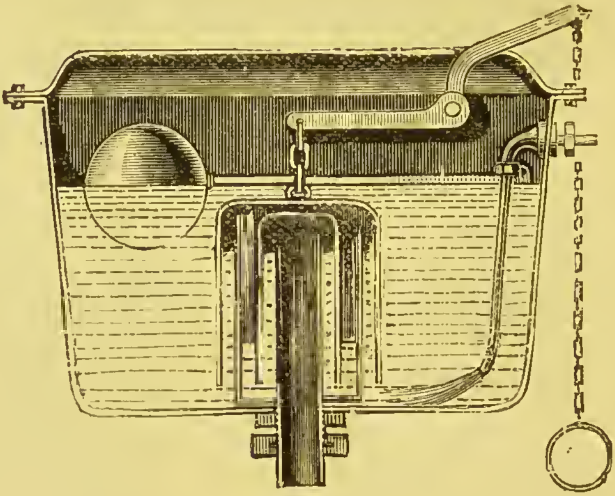

Fig. 98.

Fig. 99 illustrates a similar water-waste preventer to the above, but instead of the syphonic action being set up by the raising of the upper dome or bell through a lever and pull, a push-piece is provided having two unions, A and B. The union A is connected by means of a brass, copper, lead, or other suitable pipe, of about a quarter of an inch internal diameter, to the union A on the small pipe projecting through the bottom of the cistern, and the union B is intended to be similarly connected to some convenient part of the down or fall pipe, C. The push can be placed in any convenient position, the length of the above-mentioned connecting pipe being immaterial; it may, therefore, should the closet be cased in, take the place usually

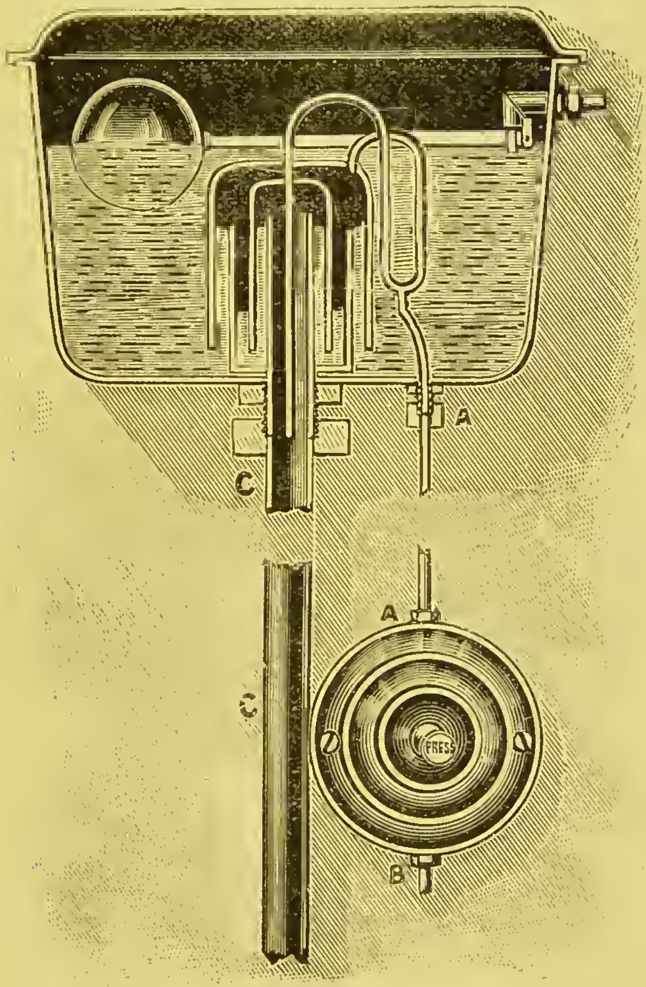

Fig. 99.

occupied by the pull-up handle in a valve-closet, or it may be fixed against the side or rear wall of the closet in such a position as to be readily get-at-able by the user. To start the syphon the push-piece must be shoved inwards, its movement being slight and the resistance inappreciable, and the air being relieved thereby from the crown of the syphon, a small quantity of water is permitted to pass and thus set up the syphonic action to empty the cistern.

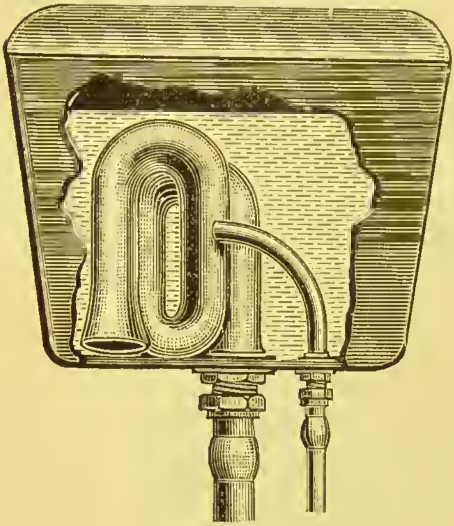

Fig. 100.

Fig. 100 illustrates a new patent syphonic water-waste preventer, invented by Mr. J. Jones, Chelsea. In this arrangement the syphon is constructed in the form of a double-coil, one convolution being higher than the other, as shown in the drawing. The normal water level in the cistern is above that of the highest portion of the coil, and the water is prevented from passing through the said coil to the down or flush pipe by the frictional resistance set up in the bends. To start the syphon a bye-pass or relief pipe connected to the first convolution of the coil and to the down pipe is provided. This bye-pass or relief-pipe is governed by a stop-valve or stop-cock of any suitable construction, or a special valve may be employed with a weighted operating lever or handle (as shown in Fig. 44) so arranged that it has to be raised or elevated to open the valve (as indicated by the dotted lines in the drawing), and will, when released, fall by gravity, and close the latter, so that it cannot be left open accidentally. On opening this valve the pressure in the coils will be relieved and the syphon started. By leaving open, or omitting the valve from the bye-pass or relief-pipe, this cistern can be employed as an automatic flushing cistern.

The flushing water is discharged very evenly and forcibly, the column of water maintaining its compactness and remaining unbroken to the last.

Displacer-started syphonic water-waste preventers are, as a rule, somewhat easier to start and more certain in action, and have a lower line of syphonage, than those arranged to work by relieving the air or pressure from the top or crown of the syphon, but they are, on the other hand, more complicated in construction, and have more working parts liable to wear and get out of order.

**Special Devices for Use with Water-waste Preventers.**—In all classes of syphonic discharge water-waste preventing-cisterns a disagreeable gurgling noise takes place when the water level reaches the bottom of the short leg of the syphon, and the seal is being broken, unless some special means are provided for admitting air to the top or crown of the syphon at this moment.

In one patent arrangement for this purpose one or more pipes of small diameter are carried from the crown or top of the syphon to near the bottom of the short leg, which pipes admit air to the top of the said syphon when the water descends to, or near, the line of syphonage.

In Fig. 101 is shown a patent anti-gurgling apparatus, invented by Messrs. J. Tylor & Sons, Limited. This device, which is intended more especially for use with a water-waste preventer of the kind or class shown in Fig. 93, comprises a vent pipe, placed upon the crown or upper end of the dome of the displacer, and governed by a suitable valve. This valve is connected through a bell-crank lever and connecting-rods with a float (not shown in the drawing), by means of which and the counter-weighted lever shown on the top, the said valve is maintained closed until the termination of the flush, when the said float descends and, through the above-mentioned lever and connecting-rods, opens the valve to allow air to enter at the top of the syphon. When fitted with this device the cistern is quite noiseless in its action, and the above-mentioned objectionable gurgling noise completely got rid of.

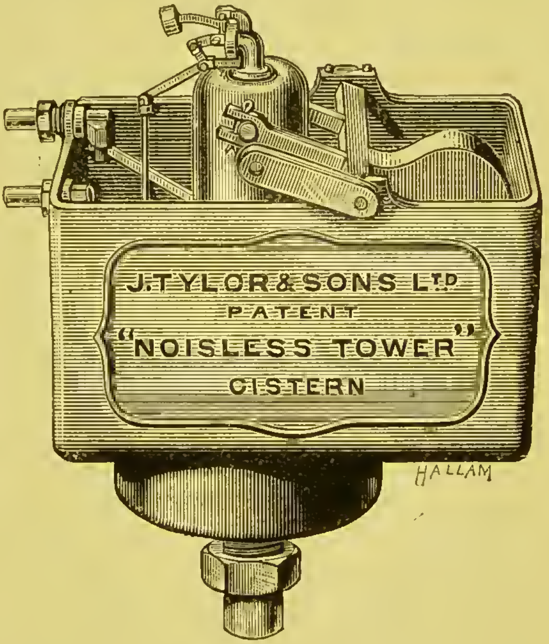

Fig. 101.

In water-waste preventing cisterns the ball-cock or valve float is usually situated in the main compartment, and the filling of this compartment is necessarily extremely slow, not only by reason of the limited area of the inlet, but also inasmuch as the said cock or valve commences to close as soon as the water reaches the ball or float and the latter begins to rise. This objection is obviated in Jenning's Patent Syphonic After-flush Cistern by arranging the float in a subsidiary chamber containing the water for the after-flush, which chamber or compartment is not filled until after the main or principal compartment is filled, or nearly so.

This advantage can be imparted in an inexpensive manner to any cistern by the handy little device shown in Fig. 102, which has been invented and patented by Mr. H. Faija, M.I.C.E., Westminster. This arrangement is applicable to almost any water-waste preventing cistern, or storage cistern, and consists of a separate vessel or receptacle, which can be easily fixed or secured by means of set screws or otherwise to the side of the cistern. This vessel is of such a form as to receive the ball or float of the ball-cock or valve, and is fitted with a small subsidiary syphon, the long leg of which extends into the said water-waste preventing or other cistern. By this arrangement the water-way through the cock remains wide open until the cistern is full, or nearly so, when the small vessel or receptacle fills suddenly, and the ball or float rises to close the said water-way.

In Fig. 102, A indicates a portion of the cistern or tank into which it is desired to regulate the flow of water or other liquid, B is the small separate vessel or receptacle which may be placed either inside or outside the said cistern or tank A, and in which the ball or float G rises and falls, actuating the cock or valve C, by which the cistern A is filled. D is a small syphon by which the water or liquid is drawn out of the vessel B into the cistern A, when the latter is being emptied. E is an air-escape hole or vent surrounded by a shield or shoe F.

The operation of the apparatus is as follows :—The cistern A, and the vessel or receptacle B, being empty, the ball or float will be in the position shown by the dotted lines, and the cock or valve C will be open, and consequently the cistern A will be filling gradually; but no liquid will flow into B until such time as the liquid or water in A has reached to about or above the top of the small syphon D, and until this desired level is reached the cock or valve C will be full open ; when the liquid has reached this level, however, it will commence to flow through the syphon D, which in this instance acts only as a conduit, quickly filling the vessel B, which is of small relative capacity, and thus the ball G will be raised, and the cock or valve C closed. As the main cistern A is emptied the vessel B will remain full, and the cock or valve C, therefore, closed, until such time as there is sufficient difference in the level of the water or liquid in the two vessels for the small syphon to start, and as the shoe F will then be full of water, the air-escape hole or vent E will be sealed, and consequently

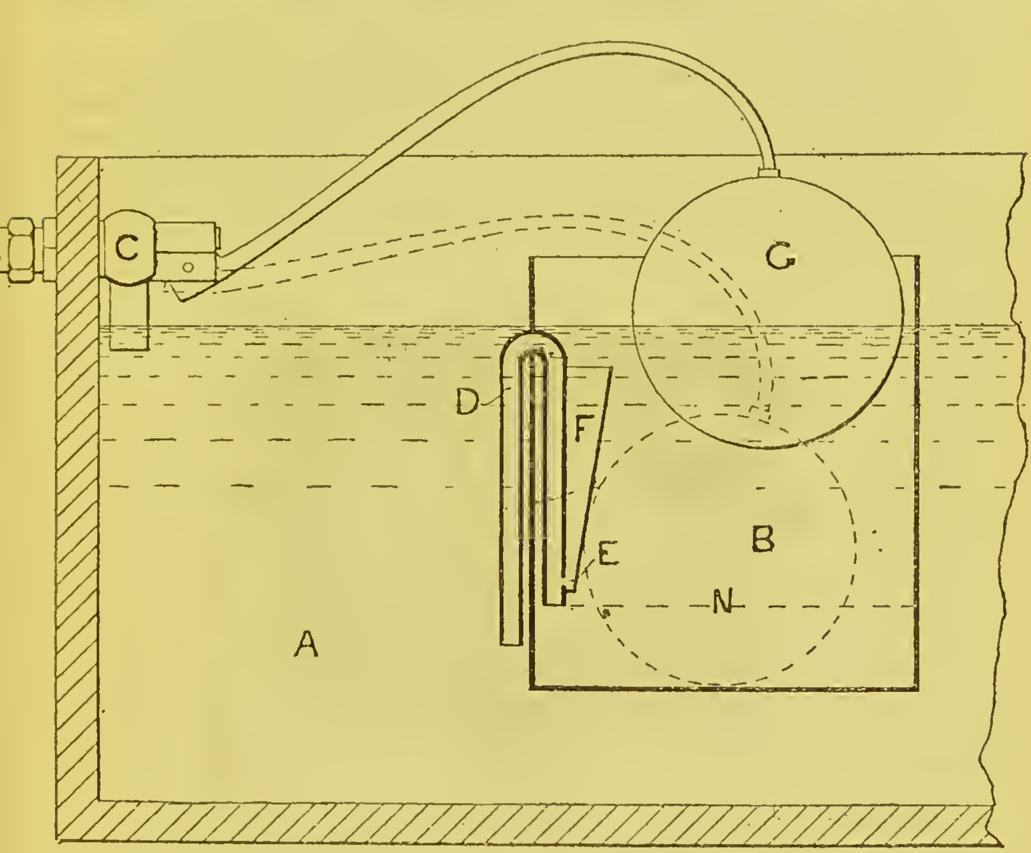

Fig. 102.

the vessel B will be emptied to any desired level below it, as, for instance, to the dotted line N. The shoe F is emptied through the air-escape hole or vent E, or through perforations in its lower portion, or through both, and will by this time be empty, and the air-escape hole E unsealed. As the cistern A fills, the water or liquid rises in the longer leg of the syphon D, and the air in the syphon is forced out through the air-escape hole or vent E, thus allowing the liquid to flow from the vessel

A into B, when the desired level in A has been reached, which flow will continue until B is full and the cock or valve C is closed, as already described. If the air-escape hole or vent E were not provided at the lower end of the short leg of the small syphon, an air cushion would be formed in the syphon as the water rose in the outer vessel, which air cushion would prevent the water flowing into the ball or float chamber B until a sufficient head of water had been obtained to overcome its resistance, which would be impossible to secure in the limited space and depth of an ordinary water-waste preventer.

Fig. 103 illustrates a valveless syphonic water-waste preventer of the vacuum class, made and patented by Mr. Milton Syer, wherein the upper extremity of the dome or bell A, which is elongated for that purpose, is provided with a small reservoir or compartment C, in which is stored a supply of a powerful disinfectant sufficient for about a thousand discharges. Enough disinfectant is discharged at each operation to charge the flushing water.

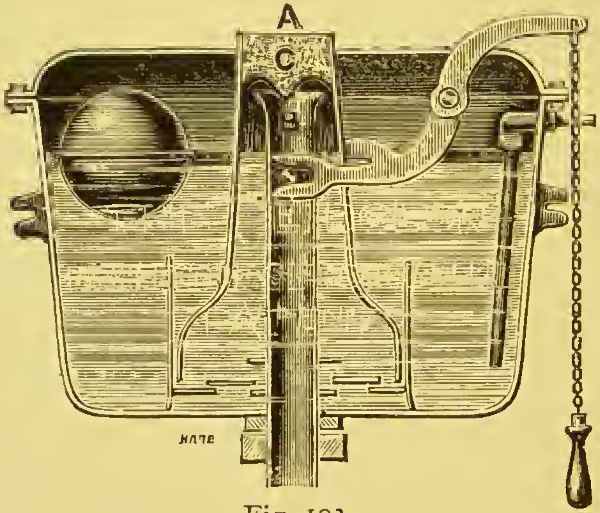

Fig. 103.

There are several devices in the market intended to be either attached to or connected with water-waste preventers, or automatic flushing tanks, and which are adapted to automatically charge the water in the said cisterns or tanks with a sufficient supply of disinfectant at each operation. These appliances usually work on the syphonic principle, and are principally employed in hospitals and the like.

# CHAPTER XIX.

## AUTOMATIC FLUSHING TANKS OR CISTERNS.

AUTOMATIC flushing tanks are now very extensively used for periodically flushing town or main sewers, and also, on a smaller scale, house drains, grease traps, trough-closets or latrines, &c., &c. They consist either in some form of tipping vessel or in a cistern fitted with a valve arranged to be automatically opened at certain given intervals by more or less complicated mechanism ; and lastly, and that more generally used, by some description of syphon so constructed that it will be automatically started or set in action upon the water reaching a certain predetermined level in the tank or cistern.

By employing an automatic flushing tank or cistern small quantities of water (such as the drainage from a scullery or kitchen sink when drawing water, washing up, &c.) which otherwise pass down the drain without any useful effect, can be stored up, and when a given quantity has been thus collected, suddenly released so as to discharge a comparatively large body of water into the drain at once, and thereby provide for efficiently flushing the same by the utilisation of water which would otherwise have run to waste.

The simplest form of automatic tipping arrangement consists in a vessel pivoted or supported on trunnions, and balanced in such a manner that when filled to a predetermined level it will turn upon its pivots and discharge its contents, after which it will return to its normal position. An apparatus of this description is shown in connection with the slop or waste water-closet, Fig. 51.

In one arrangement of valve-operated automatic flushing cistern the discharge valve is coupled by means of a connecting rod to that end of a pivoted tipping vessel having formed on, or secured to it, a water-tight compartment. When the water has reached a predetermined level in the cistern the

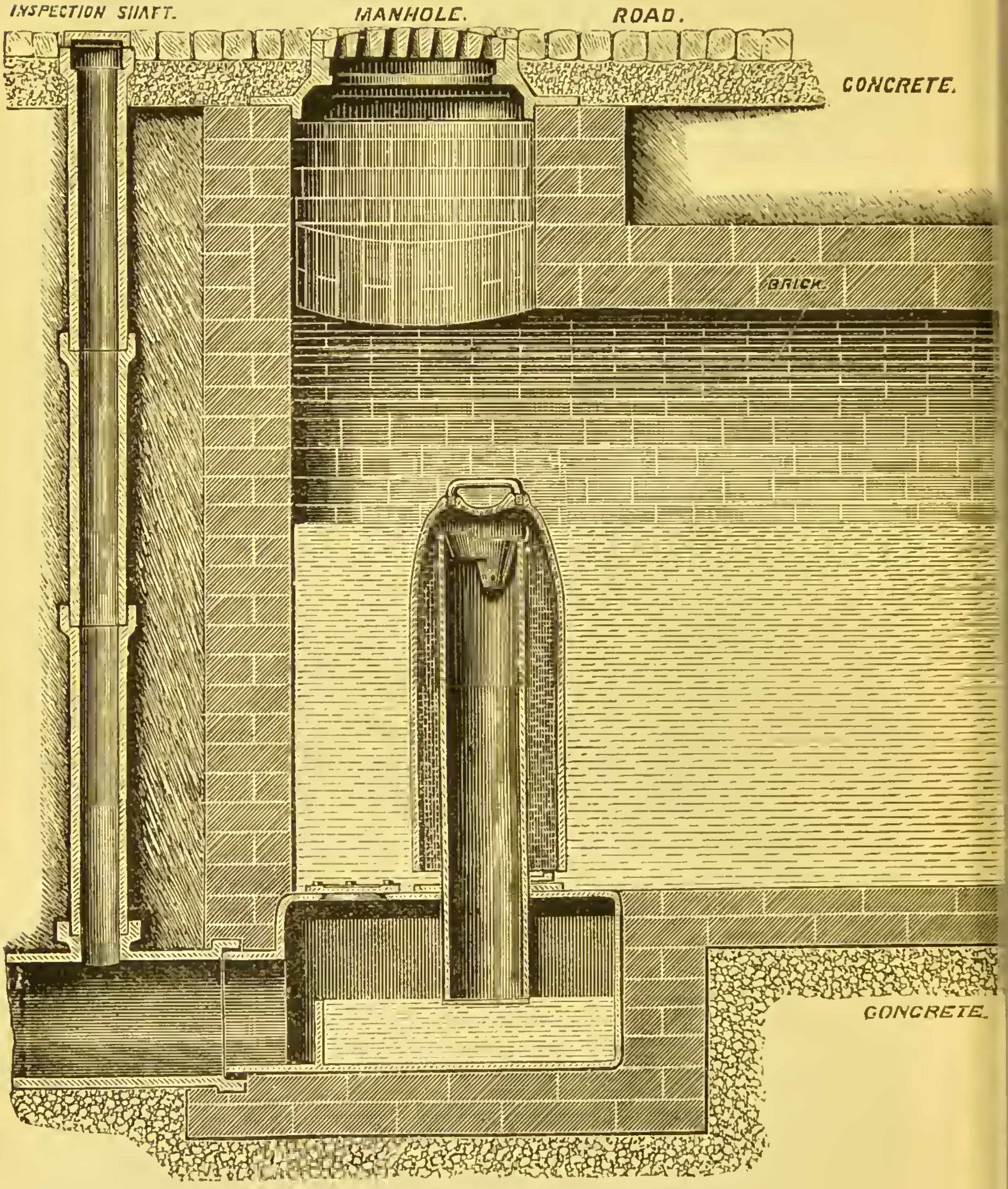

Fig. 104.

end of the pivoted vessel having the water-tight compartment or float is raised, thereby opening the valve connected therewith. The tipping vessel is retained in the above-mentioned position during the escape of the contents of the main cistern,

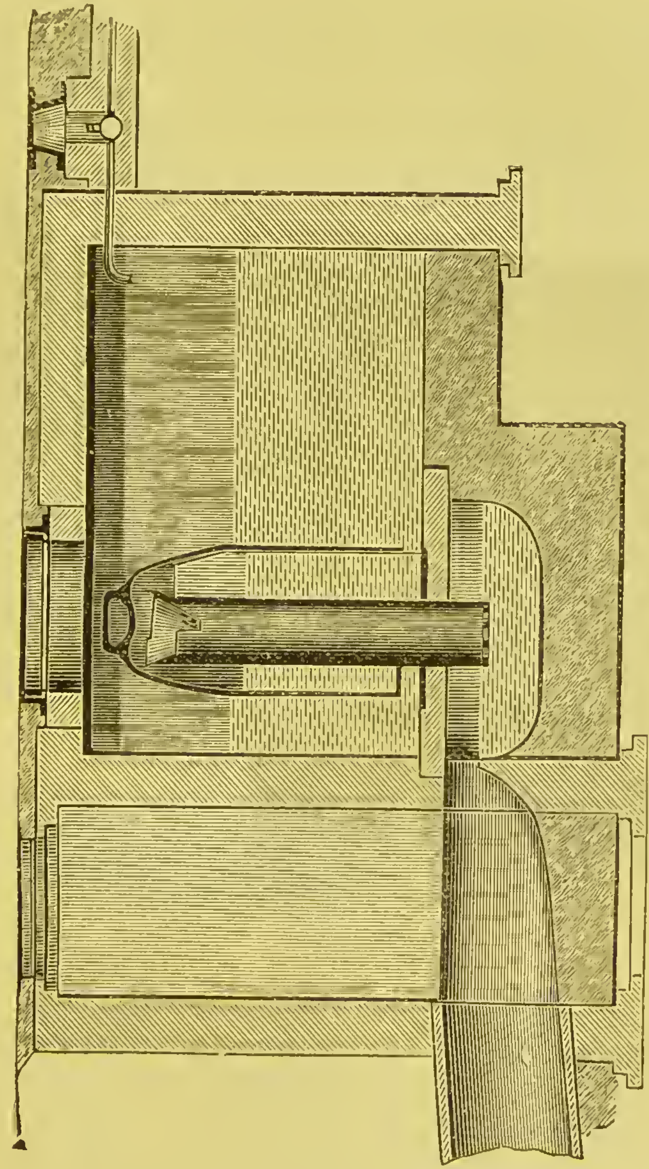

Fig. 105.

by the water that remains therein, and the aperture for permitting the said water to escape from the pivoted or tipping vessel is of such dimensions as to admit of its escaping but slowly therefrom, consequently the said vessel will be maintained in that position, and the discharge valve kept open until all the water has escaped from the main tank or cistern, when it resumes its normal position and the said discharge valve closes.

**Syphonic Discharge Automatic Flushing Tanks.**—Figs. 104, 105, and 106 show three forms of automatic flushing tanks, on the syphonic discharge principle, manufactured by Messrs. Bowes-Scott and Western, of Westminster, and fitted with Mr. Roger Field's patent syphons. Figs. 104 and 105 are arrangements intended to be placed underground or below the level of the yard, roadway, or other surface, and Fig. 106 is a pattern designed to be fixed above ground against a wall or other suitable support, as shown in Fig. 81. The syphon in each of these cisterns is of the same design, the long leg or limb thereof being arranged to dip about a quarter of an inch into, and below the surface of a body of water, retained and kept at a proper level by a weir or dam, formed in a separate and smaller tank or vessel either built into the main tank or

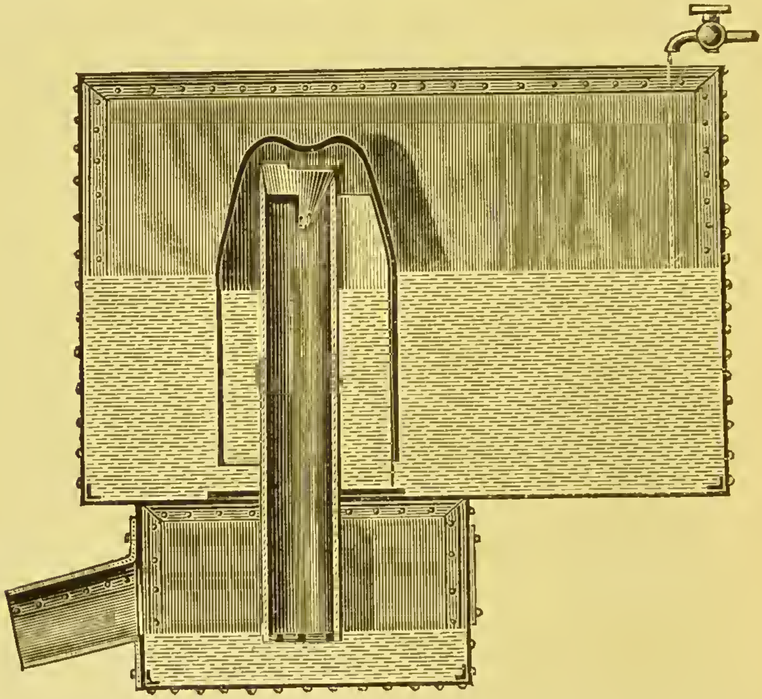

Fig. 106.

cistern, when the latter is constructed of bricks, or riveted or otherwise secured to the bottom or underside thereof, and having the discharge outlet situated at a slight distance from its bottom, as shown in Fig. 106.

The operation of the apparatus is as follows:—When the water fed into the tank or cistern from an inlet or tap at the top, rises in the dome, or short leg of the syphon, to the top of the lip or adjutage on the long leg or limb of the said syphon, it begins to flow over, at first in a succession of drops which dispel a sufficient quantity of air in the discharge pipe and bell or dome to cause the level of the liquid within the latter to rise, and thereby to increase the overflow into the discharge pipe, and thus expel a further quantity of air so as to gradually form a vacuum, which causes a still greater rise and overflow, and starts the action of the syphon by which the tank or cistern is very rapidly emptied.

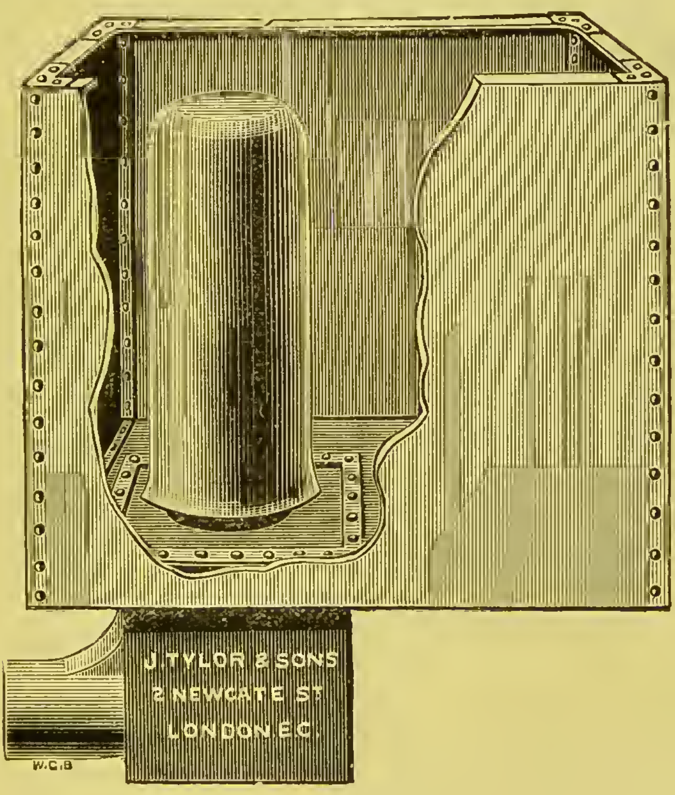

Fig. 107.

Merrill's automatic flushing tank or cistern is also of the syphonic discharge type, and is adapted for use with a trough-closet, or latrine or for other purposes. In this tank, the foot or lower extremity of the syphon dips into a tipping vessel pivoted thereto, and contained in an auxiliary chamber or well situated beneath, or on the underside of the main tank or cistern, and communicating with the discharge outlet. When the supply water overpasses the upper end of the long leg or limb of the syphon it passes down the latter, and filling this tipping vessel causes it to capsize or turn upon its pivots and discharge its contents, thereby starting the syphon and emptying the tank or cistern, after which the said tipping vessel resumes its normal position.

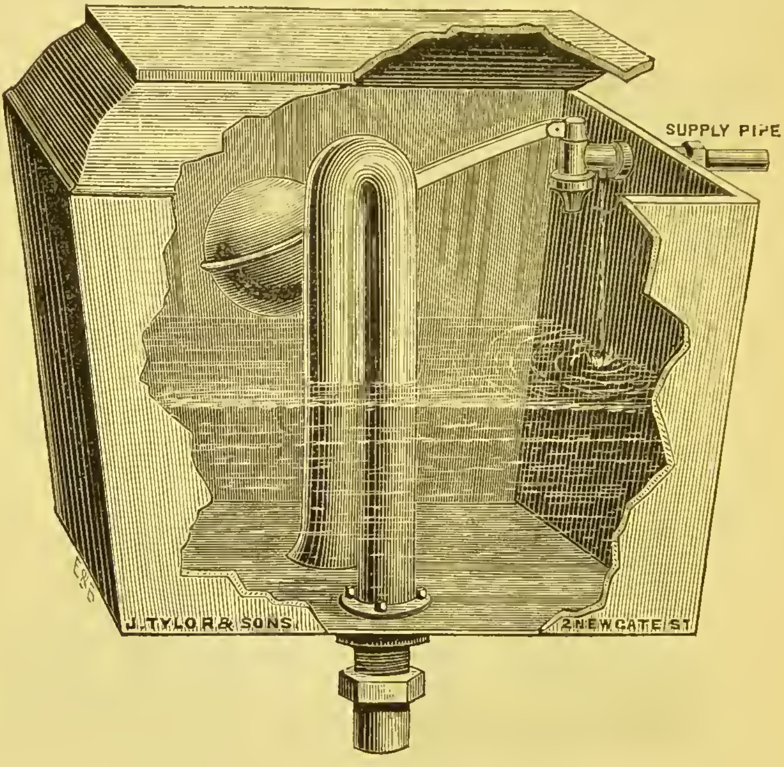

Fig. 108.

Amongst other advantages claimed for this arrangement are the following: that the syphon will work under every possible condition, either with clean water or the dirtiest slop waters, as the tipping vessel retains no dirt or sediment, but is effectively cleared and scoured out at each operation. That it cannot be tampered with, and its efficiency of action interfered with, except by actual destruction. That it requires no grease trap when slop water is employed.

In Fig. 107 is illustrated Bean's Patent Syphonic Discharge Automatic Flushing Tank or Cistern, manufactured by Messrs. J. Tylor and Sons, Limited, London. This tank is also provided with a well secured to, or formed on its underside, and is fitted with a nicely adjusted syphon, which is so set that the cistern can be made to discharge at any desired interval of time.

The hereinbefore described automatic flushing tanks can be regulated to discharge with the merest trickle of water from the cock or valve, or other source of supply, and do not dribble, the syphonic action commencing the moment the water in the tank has attained the predetermined level, and being discharged in a strong and continuous flow until the said tank is emptied.

Fig. 108 shows one of Messrs. J. Tylor and Sons' automatic syphonic discharge flushing tanks fitted with a reverse action ball-cock or valve, which, when the water reaches the predetermined level and the float rises, opens to discharge an increased amount of water into the tank and thereby to start the syphon and empty the cistern. This flushing tank or cistern is made in small sizes, and is intended principally for use with a urinal or the like.

# CHAPTER XX.

## ASH- AND DUNG-PITS, DUST-BINS, AND CESSPOOLS.

**Ash- and Dung-Pits.**—The Model Bye-Laws (see Appendix) provide that any ash-pits constructed in connection with a building shall be situated at a distance of six feet at least from any dwelling-house or building wherein any person may be or may be intended to be employed, and make also various other provisions with reference to the construction of pits or receptacles for ashes and other house refuse, and dung-pits or receptacles connected with stables or buildings for the accommodation of horses or other animals.

**Dust-bins.**—The old brick dust-bin—with wooden roof and front, and walls uncemented on the interior and usually put together with mortar of the most inferior and hygroscopic character—is far from being a desirable adjunct to a house; and still more unsanitary and undesirable to have in one's vicinity is an old wooden dust-bin. The latter, owing to the absorbent qualities of the wood, becomes in a comparatively short time thoroughly impregnated with impurities, and gives off perpetually an extremely offensive and unwholesome smell.

Portable receptacles known as Sanitary Dust-bins are now being largely used for the reception of ashes and other refuse from the dwelling-house, and these are in every way more desirable than fixed dust-bins. They are usually constructed of galvanized iron, and of a rectangular or cylindrical form, the latter being perhaps the most desirable shape in practice, inasmuch as it presents no corners for the retention of filth. Of whatever shape, however, they should be provided with a suitable tight-fitting lid or cover, and have handles by means of which they can be easily manipulated by the dust-men. The capacity of a dust-bin should be sufficient to admit of its containing at the most the accumulations of one week.

The quantity of dust removed from the metropolitan districts averages about two and a half cubic yards per house per annum.

Figs. 109 and 110 represent respectively a rectangular and a cylindrical sanitary dust-bin.

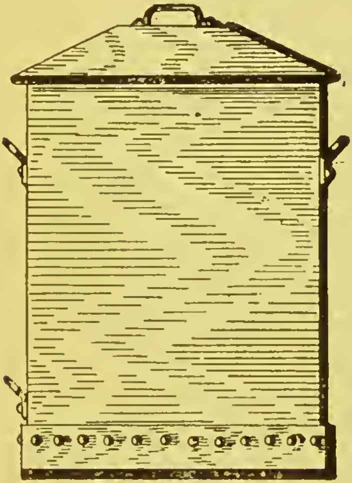

Fig. 109.

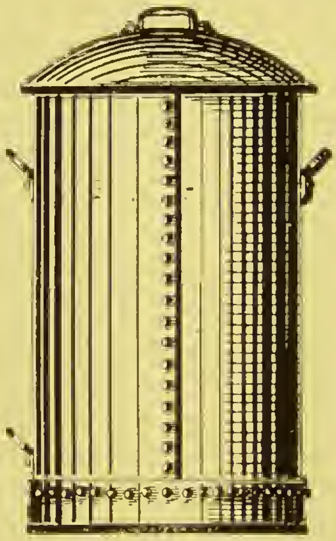

Fig. 110.

**Cesspools.**—Where the existence of a cesspool is an unavoidable necessity, care should be taken to construct it strictly in accordance with the provisions relating thereto contained in the Model Bye-Laws which will be found at the end of this book. The walls must be built of good sound bricks laid in Portland cement and properly rendered on their internal surfaces with Portland cement. There should be a backing, moreover, of well-puddled clay of at least nine inches in thickness around and beneath the brickwork.

The cesspool should be properly ventilated by means of a fresh-air inlet or inlets, and an upcast ventilating shaft or pipe, arranged to discharge the foul air and gases generated in the said cesspool or cesspit, in such a position as to be innoxious, and thus avoid the dangers to health otherwise resulting therefrom.

# CHAPTER XXI.

## SEWER VENTILATION.

THE subject of sewer ventilation is one which is of the utmost importance to the general public, as it is useless, as before mentioned, to put all the sanitary arrangements in a house in perfect order, if the main sewers in the district be in a stinking and unsanitary condition. Reference has already been made to the evils resulting from leaky and badly laid sewers, not less serious are those resulting from ill-ventilated ones. Sewer ventilation has been often discussed and many plans and theories more or less impossible have been from time to time promulgated. It is not within the scope of this work to enter with any degree of fulness into a subject of this magnitude, but it is, as above stated, a subject of such vital importance to public health that it would hardly do to entirely ignore it in a book dealing with sanitary matters, although it is but indirectly connected with the sanitary arrangement of dwelling-houses.

As has already been mentioned, the opinion of experts is and has been for years in favour of the interposition of an efficient intercepting or disconnecting trap between the soil drain of a dwelling-house and the public sewer, and as the latter are at present too often constructed and ventilated, there is no doubt about the necessity of this precaution. Were the public sewers to be perfectly constructed and ventilated, disconnector or interceptor traps would be undoubtedly unnecessary. As this, however, is a pitch of perfection unattainable in practice, although it may appear easy enough of accomplishment theoretically, it may be taken that the use of a proper trap at the junction of the house drains with the public sewer will always be a necessity, in order to prevent the egress of foul gases generated in the said sewer into the soil drain.

The most practical and best method of sewer ventilation, and one far preferable to the use of street ventilating columns, is the often proposed plan of insisting upon a ventilating pipe or shaft being carried up the wall of every house and for a certain distance above them, the said pipe or shaft being connected at its lower extremity with the drain from the house to the public sewer, on the sewer side of the intercepting or disconnecting trap. These shafts or pipes would provide ample ventilating outlets for the escape of sewer gas, and the road gratings would be then permitted to perform their proper function and act as fresh-air inlets, instead of as they do at present, acting as outlets for sewer gas and foul smells, and spreading contagion and disease. It would be practically impossible for the public authorities to provide as perfect a system of sewer ventilation by means of street ventilating columns or otherwise, as would be ensured were it to be compulsory for every house to supply its quota of ventilation.

Amongst other schemes for the ventilation of public sewers is that of employing a chimney shaft and furnace, in the latter of which the foul gases from the sewers are to be consumed by fires. This destructor is proposed to be erected in the most elevated position in the district, so as to enable it to draw off from the sewers all the gases formed.

In cases where a cremator or destructor for house refuse is in use the sewer gases might be consumed therein, and the expense of maintaining separate furnaces for that purpose avoided.

The objection to this method of sewer ventilation is the liability to the occurrence of disastrous explosions of gases in the furnaces. The expense entailed in installing and working a system of this description would also be very heavy.

Various patent methods of ventilating sewers have been from time to time devised. In one of these, patent manholes and ventilating covers having spiral trays containing charcoal are placed at frequent intervals along the course of the sewers, the gases ascending from the latter being oxidized in their passage over the charcoal. This system has usually failed, principally owing to the neglect and carelessness of those in charge, who omit to renew the supply of charcoal in the trays, which becomes in consequence compacted and saturated with moisture, and ceases to serve any useful purpose, as the oxidization of the gases is only carried out so long as the charcoal remains in a perfectly dry condition.

# CHAPTER XXII.

## VENTILATION AND HEATING OF DWELLING-HOUSES.

**Ventilation.**—The importance of having a dwelling-house properly ventilated cannot be over-estimated. A supply of fresh air may be admitted to a room * by means of the simple expedient recommended by Dr. Bird—namely, raising the lower sash and closing the aperture thus formed under the bottom rail, by means of a strip or piece of wood of corresponding dimensions, the fresh air finding its way into the room in an upward direction between the meeting rails of the sashes. Tubes arranged in the lower rail and having an upward bend are also efficacious, although unsightly.

The used-up or vitiated air may be extracted from a room by means of special flues provided in the chimney-breast. The ordinary open fire-place is itself an excellent extractor of foul air, but is unfortunately most extravagant in the consumption of fuel and wasteful of heat. Ventilators may be placed over doors which communicate with a central staircase: but in this case it is absolutely necessary to provide some efficient means of securing proper ventilation at the very top of the staircase, or else the latter will become a receiver for foul air which will ultimately pass into the bedrooms. There is no doubt that every house, large or small, should be fitted with an efficient exhaust ventilator in the roof, communicating through a suitable air shaft with the upper portion of the staircase so as to remove the vitiated air therefrom.

Inlet ventilators having internal regulating valves and arranged to be set flush with the face of the wall so as to be practically invisible, and also with air-regulating doors or shutters arranged to open outwardly into the apartment, are made in great variety by a number of firms. In some of these inlet ventilators, a removable well or receptacle is provided, intended to hold disinfectants, perfumes, ice or water, over the surface of which the air entering the room must pass.

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* The Bye-Laws of the Local Government Board require four hundred cubic feet for a single room, and three hundred cubic feet for a sleeping room for every adult, and an allowance of half these amounts for every child.

Figs. 111 and 112 are vertical sections showing two patterns of wall-inlet ventilating boxes, designed and manufactured by Messrs. Robert Boyle and Sons, Limited, London. The ventilator shown in Fig. 111 is a plain air inlet panel, intended to fit flush with the wall, and having no projection into the room. It is fitted with an inwardly opening regulating valve, an air filter, and a perforated front. The outer box or casing is of cast iron. That shown in Fig. 112 is also a plain air inlet panel intended to fit flush with the wall of the apartment and provided with an air filter; but it has a movable front opening outwardly into the said apartment to regulate the supply of air.

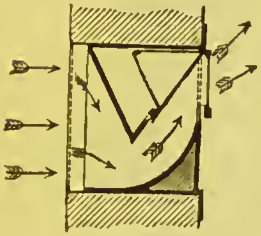
Fig. 111.

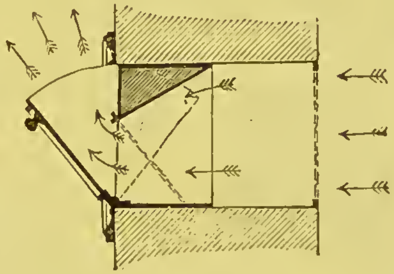
Fig. 112.

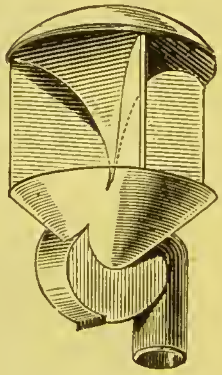
Fig. 113.

The construction and action of these inlet ventilators will moreover be very readily understood from the drawings, wherein the paths taken by the currents of air are indicated by arrows.

Fig. 113 shows a downcast ventilator made by the same firm. This ventilator is intended to be fixed upon the upper extremity of a ventilating shaft built into the wall or otherwise; and to catch the wind in the manner of a windsail, and drive it down the said shaft into the room.

Patent ventilating and smoke-consuming fire-places have also been designed by this firm, by means of which fresh atmospheric air admitted through an opening in the rear passes into an hot-air chamber, and between a series of baffle plates or gills so as to be thoroughly warmed, after which it passes through another aperture into the apartment; a suitable baffle plate being provided for directing the current of warmed fresh air in an upward direction.

Provision is also made in these fire-places for supplying air raised to a high temperature to the upper portion of the fire in the grate, thereby insuring more complete combustion of the fuel, and rendering the grate smoke-consuming. As the hydrogen usually wasted in the form of smoke is thus consumed and converted into heat, these grates form valuable fuel economisers.

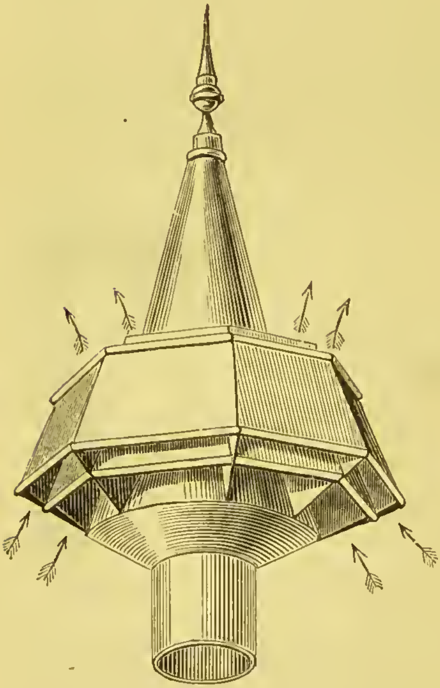

Fig. 114.

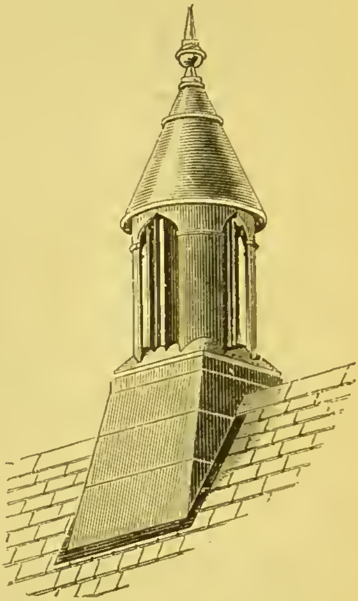

Fig. 115.

Fig. 114 illustrates Boyle's Patent Octagonal-shaped Vertical-Current Exhaust Ventilator. In this ventilator a descending current of external air is utilised to create an up-draught by a special arrangement of the deflecting plates which are placed horizontally. These ventilators are also made circular in form, and are suitable for the roofs of buildings which are surrounded by higher buildings, when it is not found convenient to carry up a shaft to the level of, or above the top of the said higher adjacent buildings.

Fig. 115 illustrates Boyle's improved patent exhaust ventilator, known as the "Air-pump Ventilator." This ventilator has attained a considerable degree of celebrity, on account of the highly satisfactory results which have been obtained from its use. It has been subjected to some very severe tests, and is one which can be confidently recommended, as being constructed on true scientific principles. Its getting out of order is impossible, as it has no moving parts, and if properly fixed its success as an extractor of foul and vitiated air is assured.

The main features of the ventilator consist in metal plates arranged at certain curves and angles, enclosing a central chamber; from this chamber the air is exhausted through a series of openings or slits, owing to the deflection of the external air across these openings at given angles in a compressed form, which thereby creates an induced current therethrough, and consequently forms a partial vacuum in the central chamber by exhausting the air therefrom. Into this central chamber the foul and vitiated air from the room being ventilated immediately ascends through the ventilating shaft, and is in like manner drawn off, and in this way a powerful and continuous upward current is established. The edges of the inner plates are protected by guards to prevent any vibration that might otherwise result by the direct impact of the wind thereon. By the provision of a series of supplementary or auxiliary exhaust arrangements the extracting power of the ventilator can be greatly increased. The ventilator is perfectly rain-proof, a space dividing the exit slit from the central chamber, serving to catch and run off any water that might find its way into the ventilator, and a deep lip or rim being also provided to prevent any water entering the said space from passing to the central chamber and down the ventilating shaft, which latter may be made of any required diameter, the extracting power depending solely, however, upon the size of the head or ventilator, and not upon the dimensions of the shaft attached to it.

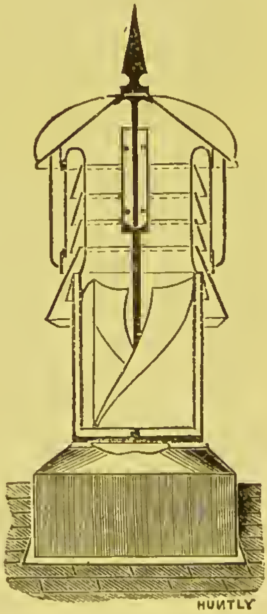

Fig. 116.

To fix the ventilator, a base or frame constructed of wood is placed in position on the ridge of the roof, as shown in the illustration, and covered with zinc, lead, or other material so as to make it perfectly watertight. The ventilator is fitted on the top of this base or frame, and is firmly secured in position thereon by means of nails, screws, or the like.

Fig. 116 shows a Patent Exhaust Ventilator, manufactured by Messrs. Wheeler and Sons, London. This ventilator is a combination of an automatic and a mechanical exhaust, and is designed for turrets, fleches, and roofs of every description. Several novel features are claimed for this ventilator, amongst which may be mentioned that as it is both automatic and mechanical it combines the advantages of both systems, the necessity of an oil chamber in the base of the ventilator is dispensed with, as the pillar is made of a sufficient length to pass through the fan, and has fixed upon its upper extremity a seamless copper oil chamber, with phosphor bronze guides, and a hardened steel centre inserted in the column or pillar.

**Heating of the Dwelling.**—Independent of combined systems of warming and ventilation, there may be said to be five distinct methods of heating at present in use, viz., by means of stoves wherein the fire is boxed or cased in and from the surfaces of which the heat is radiated into the apartment; by means of endless pipes heated by a current of hot water from a boiler; by means of pipes charged with steam; by means of hot-air flues; and by means of gas.

When warming is combined with ventilation the air previously raised to a suitable temperature is delivered into the various apartments through registers. The open fire-place may be said to belong to the latter category, and still holds its own in this country for heating purposes. It is wasteful, as it consumes a large quantity of fuel, and a considerable proportion of the heat engendered passes away up the chimney without useful effect, and is lost; but, on the other hand, it has most decided advantages in point of healthfulness, and, in the more improved forms, modern science has done much to reduce the above defects.

Large buildings can be economically and evenly warmed by means of hot-water pipes. The supply of air for ventilating purposes should be passed over the hot pipes so as to be raised to a proper temperature before passing into the room.

# CHAPTER XXIII.

## WATER SUPPLY TO THE DWELLING.

ALL dwelling-houses should be provided with a constant water service, and this should be compulsory upon water companies.

**Cisterns.**—The safest and most healthy cisterns for the storage of water in the dwelling are those constructed of slates, but they are expensive, and also objectionable on account of their excessive weight. Lead or zinc-lined tanks or cisterns are liable to be acted upon injuriously by some waters, and although considerable differences of opinion exist amongst chemists as regards the long-continued action of water on lead, it is probably best to avoid its use. Galvanized iron forms a very good material for storage cisterns for domestic use, and those constructed of this material are in all probability the best for general purposes. Water cisterns should be carefully covered so as to exclude light and dust, and they should be properly cleaned out at least once in every three months.

The down, or supply pipe from a cistern should be fitted with a stop cock or valve placed directly under the said cistern, to enable the supply to be cut off for repairs. It is also a good plan to have a draw-off cock or valve on the main supply pipe, on the house side of the stopcock or valve required by the water company, so as to enable the house pipes to be cleared of water in frosty weather. This arrrangement is more especially desirable in cases where there is a constant service.

**Ball Cocks or Valves.**—These are important fittings in connection with water storage cisterns, and to avoid trouble they should always be of the very best quality and design obtainable.

The ordinary ball-cock or valve consists in a casing having a knife-edge valve seating, and a cylindrical valve faced with india-rubber and adapted to be moved horizontally to and from the said seating, in an extension upon the said casing, by means of an arm or projection upon the ball or float lever, which works in a slot or recess in the said valve. The water is delivered through a nozzle formed at right angles to the said casing. In some instances the valve is arranged to move in a vertical direction in a right-angled extension upon the casing, the ball or float arm or lever passing through a slot formed in the said valve. Slots or grooves are then provided in the interior face of the said extension or valve guide to form waterways or passages.

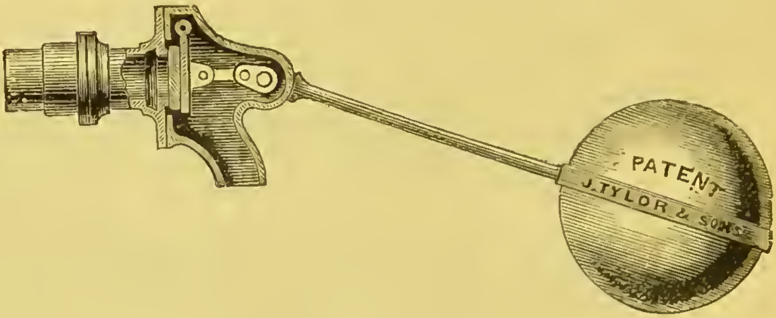

Fig. 117.

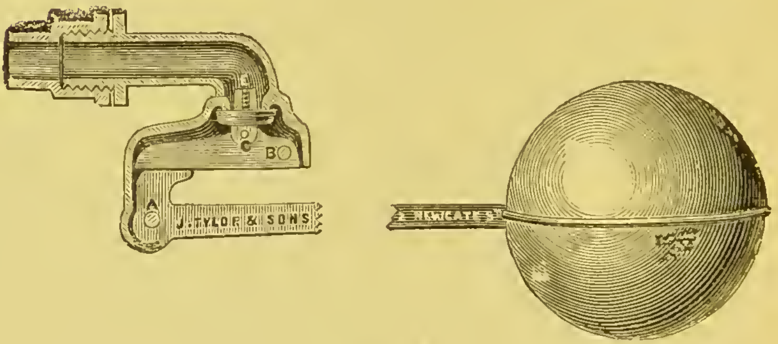

Fig. 118.

In a type of ball-cock or valve known as the "equilibrium," the water is admitted to both sides of the valve, thereby equilizing the pressure thereon, and facilitating its movement to and from its seating, and furthermore reducing, or entirely getting rid of the tendency to stick, to which valves of ordinary or common construction are more or less liable.

Figs. 117 and 118 illustrate two patent ball-cocks or valves designed by Messrs. J. Tylor and Sons, Limited.

That illustrated in Fig. 117 is a full-way ball-valve, and is suitable for use with any pressure up to eighty feet. The valve in this case consists in a disc faced with india-rubber or other suitable material, and hinged or pivoted to the interior of the casing. This flap-valve is coupled by means of a link or connecting rod to a crank arm or lever secured upon the inner end of a spindle, to the outer end or extremity of which is secured the ball or float arm or lever. The crank arm and connecting rod or link are so fixed or adjusted that when the ball or float falls the valve will be opened, and when the said ball or float rises under the action of the water, the said valve will be closed, and retained firmly against its seating.

Fig. 118 shows a ball valve suited for use with high pressures up to 450 feet. As will be seen from the drawing, it is fitted with a double or compound lever. The copper ball, or float arm or lever, is pivoted at A to an extension on the valve casing, and has an arm or projection which engages with the free end of a second or intermediate lever pivoted at B to the said casing, and coupled or connected at C to the valve E. The power exercised by the main lever or float arm to keep the valve against its seating is thus multiplied.

**Water.**—The quantity of water estimated as being required for a town's water supply is thirty gallons per head per day, for all purposes, such as for domestic supply, use in manufactories, at fires, for flushing sewers, cleaning streets, and watering parks, gardens, &c., &c. In domestic households the average consumption is about fifteen gallons per head per day, in hospitals from twenty-five to thirty gallons per head per day, and in stables about eighteen gallons per horse per day, this latter includes the water required for washing horse, stable, and vehicle.

Water is divided into two kinds or classes, soft and hard, the latter having two degress of hardness, viz., permanent and temporary. Permanent hardness is caused by the water containing sulphates of lime, magnesia, iron, &c., &c., which ingredients are not removable by boiling, but form an objectionable incrustation or deposit. Temporary hardness is caused by the water containing bicarbonates which can be removed by boiling, the carbonic acid released by the latter operation separating the bicarbonate of lime and precipitating it. Hard water is

# APPENDIX.

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## (A.) Public Health Act, 1875.

The following sections of this Act affect and are of interest to householders, as persons offending against them are liable to summary conviction, and incur various penalties :—

Sec. 21.—Constructing a drain so as to empty into a sewer of any local authority without complying with the regulations.

Sec. 25.—Not providing a new house or building with properly-constructed and covered drains in an urban district.

Sec. 26.—The building over sewers and under streets in urban districts without written consent from the urban authority.

Sec. 35.—Not providing a new house, or one recently rebuilt, with sufficient water-closet, earth-closet, or privy accommodation, and an ashpit fitted with proper doors and coverings.

Sec. 41.—Neglecting, after due notice from the local authority, to execute any repairs or do any necessary work to privies.

Sec. 42.—Either removing or obstructing the removal of any matter collected by a local authority.

Sec. 43.—In cases where local authorities have undertaken or contracted to remove house-refuse, &c., and fail to do so within seven days, after notice in writing, without some reasonable excuse.

Sec. 44.—Causing nuisance by failing to remove snow, filth, dust, ashes, and rubbish, and keeping animals on any premises so as to be injurious to health.

Sec. 46.—Not complying with notice from a local authority to whitewash, cleanse, or purify a house or part thereof.

Sec. 47.—The keeping of swine in any dwelling-house, or in such a place as to be a nuisance to any person. Suffering stagnant water, filth, or waste to remain in any dwelling-house for twenty-four hours after written notice from urban authority to remove same ; or allowing the contents of any water-closet, privy, or cesspool to overflow or soak therefrom.

Secs. 48 and 50.—Failing after notice to periodically remove manure or other refuse from stables, mews, &c., &c.

## (B.) PUBLIC HEALTH (LONDON) ACT, 1891.

Sanitary authority to inspect district for detection of nuisances.

1. It shall be the duty of every sanitary authority to cause to be made, from time to time, inspection of their district, with a view to ascertain what nuisances exist calling for abatement under the powers of this Act, and to enforce the provisions of this Act for the purpose of abating the same, and otherwise to put in force the powers vested in them relating to public health and local government, so as to secure the proper sanitary condition of all premises within their district.

### NUISANCES (GENERAL).

What nuisances may be abated summarily.

2. For the purposes of this Act,—

- (*a*) Any premises in such a state as to be a nuisance or injurious or dangerous to health.
- (*b*) Any pool, ditch, gutter, watercourse, cistern, water-closet, earth-closet, privy, urinal, cesspool, drain, dung-pit, or ash-pit, so foul or in such a state as to be a nuisance or injurious or dangerous to health.
- (*c*) Any animal kept in such place or manner as to be a nuisance or injurious or dangerous to health.
- (*d*) Any accumulation or deposit which is a nuisance or injurious or dangerous to health.
- (*e*) Any house or part of a house so overcrowded as to be injurious or dangerous to the health of the inmates, whether or not members of the same family.
- (*f*) Any such absence from premises of water-fittings as is a nuisance by virtue of Section 33 of the Metropolis Water Act, 1871, set out in the First Schedule to this Act. And,
- (*g*) Any factory, workshop, or work-place which is not a factory, subject to the provisions of the Factory and Workshop Act, 1878, relating to cleanliness, ventilation, and overcrowding.

Information of nuisances to sanitary authority.

3. Information of a nuisance liable to be dealt with summarily under this Act in the district of a sanitary authority may be given to that authority by any person, and it shall be the duty of every officer of that authority, and of every relieving officer in accordance with the regulations of the authority having control over him, to give that information; and it shall be the duty of the said authority to make the said regulations, and also the

duty of the sanitary authority to give such directions to their officers, as will secure the existence of the nuisance being immediately brought to the notice of any person who may be required to abate it, and the officer shall do so by serving a written intimation.

**Notice requiring abatement of nuisance.**

4. (1) On the receipt of any information respecting the existence of a nuisance liable to be dealt with summarily under this Act, the sanitary authority shall, if satisfied of the existence of a nuisance, serve a notice on the person by whose act, default, or sufferance the nuisance arises or continues, or if such person cannot be found, on the occupier or owner of the premises on which the nuisance arises requiring him to abate the same within the time specified in the notice, and to execute such works and do such things as may be necessary for that purpose, and if the sanitary authority think it desirable (but not otherwise), specifying any works to be executed.

(2) The sanitary authority may also, by the same or another notice served on such occupier, owner, or person, require him to do what is necessary for preventing the recurrence of the nuisance, and, if they think it desirable, specify any works to be executed for that purpose, and may serve that notice, notwithstanding that the nuisance may for the time have been abated, if the sanitary authority consider that it is likely to recur on the same premises.

**On non-compliance with notice, order to be made.**

5. (1) If either—

(*a*) The person on whom a notice to abate a nuisance has been served, as aforesaid, makes default in complying with any of the requisitions thereof within the time specified; or,

(*b*) The nuisance, although abated since the service of the notice, is, in the opinion of the sanitary authority, likely to recur on the same premises, the sanitary authority shall make a complaint, and the petty sessional court hearing the complaint may make on such person a summary order (in this Act referred to as a nuisance order).

(2) A nuisance order may be an abatement order, a prohibition order, or a closing order, or a combination of such orders.

(3) An abatement order may require a person to comply with all or any of the requisitions of the notice, or otherwise to abate the nuisance within a time specified in the order.

(4) A prohibition order may prohibit the recurrence of a nuisance.

(5) An abatement order or prohibition order shall, if the person on whom the order is made so requires, or the court considers it desirable, specify the works to be executed by such person, for the purpose of abating or preventing the recurrence of the nuisance.

(6) A closing order may prohibit a dwelling-house from being used for human habitation.

(7) A closing order shall only be made where it is proved to

the satisfaction of the court, that by reason of a nuisance a dwelling-house is unfit for human habitation, and if such proof is given, the court shall make a closing order, and may impose a fine not exceeding twenty pounds.

(8) A petty sessional court, when satisfied that the dwelling-house has been rendered fit for human habitation, may declare that it is so satisfied and cancel the closing order.

(9) If a person fails to comply with the provisions of a nuisance order with respect to the abatement of a nuisance, he shall, unless he satisfies the court that he has used all due diligence to carry out such order, be liable to a fine not exceeding twenty shillings a day during his default; and if a person knowingly and wilfully acts contrary to a prohibition or closing order, he shall be liable to a fine not exceeding forty shillings a day during such contrary action. Moreover, the sanitary authority may enter the premises to which a nuisance relates, and abate or remove the nuisance, and do whatever may be necessary in execution of such order.

Power of entry.

(10) The sanitary authority shall have a right to enter from time to time any premises:

(*a*) For the purpose of examining as to the existence thereon of any nuisance liable to be dealt with summarily under this Act, at any hour by day, or in the case of a nuisance arising in respect of any business, then at any hour when that business is in progress or is usually carried on; and,

(*b*) Where under this Act a nuisance has been ascertained to exist, or a nuisance order has been made, then at any such hour as aforesaid, until the nuisance is abated, or the works ordered to be done are completed, or the closing order is cancelled, as the case may be; and,

(*c*) Where a nuisance order has not been complied with, or has been infringed, at all reasonable hours, including all hours during which business therein is in progress, or is usually carried on, for the purpose of executing the order.

Costs of execution of provisions relating to nuisances.

11. (1) All reasonable costs and expenses incurred in serving notice, making a complaint, or obtaining a nuisance order, or in carrying the order into effect, shall be deemed to be money paid for the use and at the request of the person on whom the order is made; or if the order is made on the sanitary authority, or if no order is made, but the nuisance is proved to have existed when the notice was served or the complaint made, then of the person by whose act, default, or sufferance, the nuisance was caused; and in cases of nuisances caused by the act or default of the owner of premises, such costs and expenses may be recovered from any person who is for the time being owner of such premises.

(2) Such costs and expenses, and any fines incurred in relation to any such nuisance, may be recovered in a summary manner, or in the county court or high court, and the court

shall have power to divide costs, expenses, and fines between persons by whose acts, defaults, or sufferance a nuisance is caused, as it may seem just.

Power of individual to complain to justice of nuisance.

12. (1) Complaint of the existence of a nuisance liable to be dealt with summarily under this Act on any premises within the district of any sanitary authority, may be made by any person, and thereupon the like proceedings shall be had with the like incidents and consequences as to making of orders, fines for disobedience of orders, appeal, and otherwise, as in the case of a like complaint by the sanitary authority.

(2) Provided that the court may, if it think fit,—

(*a*) Adjourn the hearing or further hearing of the complaint for the purpose of having an examination of the premises where the nuisance is alleged to exist, and may authorise the entry into such premises of any constable or other person for that purpose; and,

(*b*) Authorise any constable or other person to do all necessary acts for executing an order made on a complaint under this section, and to recover the expenses from the person on whom the order is made in a summary manner.

(3) Any constable or other person authorised under this section shall have the like powers, and be subject to the like restrictions, as if he were an officer of the sanitary authority, authorised under the foregoing provisions of this Act to enter any premises and do any acts thereon.

Proceedings in high court for abatement of nuisances.

13. The sanitary authority may, if in their opinion summary proceedings would afford an inadequate remedy, cause any proceedings to be taken against any person in the High Court, to enforce the abatement or prohibition of any nuisance liable to be dealt with summarily under this Act, or for the recovery of any fines from, or for the punishment of, any persons offending against the provisions of this Act relating to such nuisances, and may pay as expenses of the execution of this Act their expenses of, and incident to all such proceedings.

Penalty for injuring closets, &c., so as to cause a nuisance.

15. If a person causes any drain, water-closet, earth-closet, privy, or ash-pit to be a nuisance, or injurious or dangerous to health, by wilfully destroying or damaging the same, or any water-supply, apparatus, pipe, or work connected therewith, or by otherwise wilfully stopping up, or wilfully interfering with, or improperly using the same, or any such water-supply, apparatus, pipe, or work, he shall be liable to a fine not exceeding five pounds

## REGULATIONS AS TO WATER-CLOSETS, &C.

Obligation to provide water-closets, &c.

37. (1) It shall not be lawful newly to erect any house, or to rebuild any house pulled down to or below the ground-floor, without a sufficient ash-pit furnished with proper doors and

coverings, and one or more proper and sufficient water-closets, according as circumstances may require, furnished with suitable water-supply and water-apparatus, and with suitable trapped soil-pan, and other suitable works and arrangements, so far as may be necessary to insure the efficient operation thereof.

(2) If any person offends against the foregoing enactment of this section, he shall be liable to a fine not exceeding twenty pounds.

(3) If at any time it appears to the sanitary authority that any house, whether built before or after the commencement of this Act, is without such ash-pit or water-closets aforesaid, the sanitary authority shall cause notice to be served on the owner or occupier of the house, requiring him forthwith, or within such reasonable time as is specified in the notice, to provide the same in accordance with the notice; and if the notice is not complied with, the said owner or occupier shall be liable to a fine not exceeding five pounds, and a further fine not exceeding forty shillings, for each day during which the offence continues; or the sanitary authority, if they think fit, in lieu of proceeding for a fine, may enter on the premises, and execute such works as the case may require, and may recover the expenses incurred by them in so doing from the owner of the house.

(4) Provided that—

(*a*) Where sewerage or water supply sufficient for a water-closet is not reasonably available, this section shall be complied with by the provision of a privy, or earth-closet; and

(*b*) Where a water-closet has, before the commencement of this Act, been and is used in common by the inmates of two or more houses, and in the opinion of the sanitary authority may continue to be properly so used, they need not require a water-closet to be provided for each house.

(5) Any person who thinks himself aggrieved by any notice or act of a Sanitary Authority under this section may appeal to the County Council, whose decision shall be final.

Power for sanitary authority to authorise examination of water-closets, &c.

40. (1) The sanitary authority may examine any of the following works—that is to say, any water-closet, earth-closet, privy, ash-pit, or cesspool, and any water-supply, sink, trap, siphon, pipe, or other works or apparatus connected therewith, upon any premises within their district, and for that purpose, or for the purpose of ascertaining the course of a drain, may at all reasonable times by day, after twenty-four hours' notice has been served on the occupier of the premises, or, if they are unoccupied, on the owner, or in case of emergency without notice, enter on any premises, and cause the ground to be opened in any place they think fit, doing as little damage as may be.

(2) If any such work as aforesaid is found on examination to be in accordance with this Act and the bye-laws of the County Council, and sanitary authority, and directions of the sanitary authority given in any notice under this Act, and in proper order and condition, the sanitary authority shall cause the same to be reinstated and made good as soon as may be, and shall

defray the expenses of examination, reinstating, and making good the same, and pay full compensation for all damages or injuries done or occasioned by the examination; but if, on examination, any such work is found not to be in proper order or condition, or not to have been made or provided by any person according to the said bye-laws and directions, or to be contrary to this Act, the reasonable expenses of the examination shall be repaid to the sanitary authority by the person offending, and may be recovered by that authority in a summary manner.

Penalty on persons improperly making or altering water-closets, &c.

41. (1) In any of the following cases—

(*a*) If, on such examination as in the preceding section mentioned, any such work as therein mentioned is found not to have been made or provided by any person according to the bye-laws of the County Council, and sanitary authority, and the directions of the sanitary authority, given in any notice under this Act, or to be contrary to this Act; or,

(*b*) If a person, without the consent of the sanitary authority, constructs or rebuilds any water-closet, earth-closet, privy, ash-pit, or cesspool which has been ordered by them either not to be made, or to be demolished; or,

(*c*) If a person discontinues any water supply without lawful authority; or,

(*d*) If a person destroys any sink, trap, siphon, pipe, or any connected works or apparatus, as aforesaid, either without lawful authority or so that the destruction creates a nuisance, or is injurious or dangerous to health.

Every person so offending shall be liable to a fine not exceeding ten pounds; and if he does not, within fourteen days after notice is served on him by the sanitary authority, or within any further time allowed by that authority, or appearing to a petty sessional court necessary for the execution of the works, cause such water-closet, earth-closet, privy, ash-pit, or cesspool to be altered or reinstated in conformity with the said bye-laws and directions, or, as the case may be, to be demolished, or such water supply to be renewed, or such sink, trap, siphon, pipe, or other connected works or apparatus to be restored, such person shall be liable to a fine not exceeding twenty shillings for each day during which the offence continues; or the sanitary authority if they think fit, in lieu of proceeding for a fine, may enter on the premises and cause the work to be done, and the expenses thereof shall be paid by the person who has offended.

(2) If, on such examination as aforesaid, any water-closet, earth-closet, privy, ash-pit, or cesspool, or any water supply, sink, trap, siphon, pipe, or any of the connected works or apparatus as aforesaid, appears to be in bad order or condition, or to require cleansing, alteration, or amendment, or to be filled up, the sanitary authority shall cause notice to be served on the owner or occupier of the premises, upon or in respect of which

the inspection was made, requiring him forthwith, or within a reasonable time specified in the notice, to do what is necessary to place the work in proper order and condition; and if such notice is not complied with, the said owner or occupier shall be liable to a fine not exceeding five pounds, and to a further fine not exceeding forty shillings for each day during which the offence continues; or the sanitary authority, if they think fit, in lieu of proceeding for a fine, may enter on the premises and execute the works, and the expenses incurred by them in so doing shall be paid to them by the owner or occupier of the premises.

(3) Any person who thinks himself aggrieved by any notice or act of a sanitary authority under this section, in relation to any water-closet, earth-closet, privy, ash-pit, or cesspool may appeal to the County Council, whose decision shall be final.

**Improper construction or repair of water-closet or drain.**

42.—If a water-closet or drain is so constructed or repaired as to be a nuisance, or injurious or dangerous to health, the person who undertook or executed such construction or repair shall, unless he shows that such construction or repair was not due to any wilful act, neglect, or default, be liable to a fine not exceeding twenty pounds :

Provided that where a person is charged with an offence under this section he shall be entitled, upon information duly laid by him, to have any other person, being his agent, servant or workman, whom he charges as the actual offender, brought before the Court at the time appointed for hearing the charge, and if he proves to the satisfaction of the Court that he had used due diligence to prevent the commission of the offence, and that the said other person committed the offence without his knowledge, consent, or connivance, he shall be exempt from any fine, and the said other person may be summarily convicted of the offence.

## (C.) MODEL BYE-LAWS.

In connection with the Public Health Act a series of model bye-laws have been framed by the Local Government Board for the use of urban sanitary authorities. In the preparation of these forms the Board obtained the assistance of advisers whose practical experience rendered their criticism of the proposed clauses of especial value.

As these bye-laws (more or less altered in some cases to suit the special circumstances of a particular district) have been extensively adopted by local governing bodies, those clauses relating to the drainage of buildings, &c., &c., which most concern and interest the inhabitants of a dwelling, are appended. Whether, however, adopted or not in the district inhabited or proposed to be inhabited by the reader, he would do well to study them for his own use and information; and should he have occasion to build a new house, or have any alterations to an old one carried out, to insist upon the provisos therein contained being rigidly adhered to.

Draining of subsoil.

Every person who shall erect a new building shall cause the subsoil of the site of such building to be effectually drained by means of suitable earthenware field pipes, properly laid to a suitable outfall, whenever the dampness of the site renders such a precaution necessary.

He shall not lay any such pipe in such a manner or in such a position as to communicate directly with any sewer or cesspool, or with any drain constructed or adapted to be used for conveying sewage, but shall provide a suitable trap, with a ventilating opening at a point in the line of the subsoil drain as near as may be practicable to such trap.

Down-spouts for rain-water.

Every person who shall erect a new building shall cause a suitable pipe or trunk, extending from the roof of such building to the ground, to be fixed to the front or rear, or to one of the sides of such building, and to be so connected with a gutter-shoot or trough—receiving any water that may fall on the roof—as to carry all such water therefrom without causing dampness in any part of any wall or foundation of such building.

Lowest storey to be at level above sewer.

Every person who shall erect a building shall construct the lowest storey of such building at such level as will allow of the construction of a drain sufficient for the effectual drainage of such building, and of the provision of requisite communication with any sewer into which such drain may lawfully empty at a point in the upper half diameter of such sewer, or with any other means of drainage, with which such drain may lawfully communicate.

Materials &c., for drains.

Every person who shall erect a new building shall, in the construction of every drain of such building, other than a drain constructed in pursuance of the bye-law in that behalf for the drainage of the subsoil of the site of such building, use good sound pipes formed of glazed stoneware or other equally suitable material.

He shall cause every such drain to be of adequate size, and if constructed or adapted to be used for conveying sewage, to have an internal diameter not less than four inches, and to be laid in a bed of good concrete, with a proper fall, and with water-tight, socketed, or other suitable joints.

He shall not construct any such drain so as to pass under any building, except in any case where any other mode of construction may be impracticable, and in that case he shall cause such drain to be so laid in the ground that there shall be a distance equal at the least to the full diameter thereof between the top of such drain, at its highest point, and the surface of the ground under such building.

He shall also cause such drain to be laid in a direct line for the whole distance beneath such building, and to be completely embedded in, and covered with, good solid concrete at least six inches thick all round. He shall likewise cause adequate means of ventilation to be provided in connection with such drain at each end of such portion thereof as is beneath such building.

He shall cause every inlet to any drain, not being an inlet provided in pursuance of the bye-law in that behalf as an opening for the ventilation of such drain, to be properly trapped.

Drains to be trapped from sewer.

Every person who shall erect a new building shall provide within the curtilage thereof, in every main drain or other drain of such building, which may directly communicate with any sewer or other means of drainage into which such drain may lawfully empty, a suitable trap at a point as distant as may be practicable from such building, and as near as may be practicable to the point at which such drain may be connected with such sewer or other means of drainage.

No right-angled drain junction.

A person who shall erect a new building shall not construct the several drains of such building in such a manner as to form in such drains any right-angled junction, either vertical or horizontal. He shall cause every branch drain or tributary drain to open into another drain obliquely in the direction of the flow of such drain.

Water supply to water-closet to be distinct from that for domestic use.

Every person who shall construct a water-closet in connection with a building, shall furnish such water-closet with a separate cistern, or flushing box, of adequate capacity, which shall be so constructed, fitted, and placed as to admit of the supply of water for use in such water-closet without any direct connection between any service-pipe upon the premises, and any part of the apparatus of such water-closet other than such cistern or flushing box.

He shall furnish such water-closet with a suitable apparatus for the effectual application of water to any pan, basin, or other receptacle with which such apparatus may be connected and used, and for the effectual flushing and cleansing of such pan, basin, or other receptacle, and for the prompt and effectual removal therefrom of any solid or liquid filth which may from time to time be deposited therein.

He shall furnish such water-closet with a pan, basin, or other suitable receptacle of non-absorbent material, and of such shape, of such capacity, and of such mode of construction as to receive and contain a sufficient quantity of water, and to allow all filth which may from time to time be deposited in such pan, basin, or receptacle to fall free of the sides thereof, and directly into the water received and contained in such pan, basin, or receptacle.

He shall not construct or fix under such pan, basin, or receptacle any " container " or other similar fitting.

He shall not construct or fix in or in connection with the water-closet apparatus any trap of the kind known as a " D trap."

Earth-closets to have dry earth receptacles.

Every person who shall construct an earth-closet in connection with a building shall furnish such earth-closet with a receptacle of suitable construction and of adequate capacity, for dry earth or other deodorizing substance, and he shall construct and fix such receptacle in such a manner, and in such a position as to admit of ready access to such receptacle for the purpose of depositing therein the necessary supply of dry earth or other deodorizing substance.

He shall construct or fix in connection with such receptacle suitable means or apparatus for the frequent and effectual application of a sufficient quantity of dry earth or other deodorizing substance to any filth which may from time to time be deposited in any pan, pit, or other receptacle for filth constructed, fitted, or used in, or in connection with, such earth closet.

As to earth-closets having fixed receptacles.

Every person who shall construct an earth-closet in connection with a building, and shall provide in or in connection with such earth-closet a fixed receptacle for filth, shall construct or fix such receptacle in such a manner and in such a position as to admit of the frequent and effectual application of a sufficient quantity of dry earth or other deodorizing substance to any filth which may from time to time be deposited in such receptacle, and in such manner and in such a position as to admit of ready access to such receptacle for the purpose of removing the contents thereof.

As to earth-closets having movable receptacles.

Every person who shall construct an earth-closet in connection with a building, and shall provide in or in connection with such earth-closet a moveable receptacle for filth, shall construct such earth-closet so that the position and mode of fitting of such receptacle may admit of the frequent and effectual application of a sufficient quantity of dry earth or other deodorizing substance to any filth which may from time to time be deposited in such receptacle, and may also admit of ready access to that part of the earth-closet in which such receptacle may be placed or fitted, and of the convenient removal of such receptacle, or of the contents thereof.

He shall also construct such earth-closet so that the contents of such receptacle may not at any time be exposed to any rainfall, or to the drainings of any waste water or liquid refuse from any adjoining premises.

Proximity of privies to buildings.

Every person who shall construct a privy in connection with a building, shall construct such privy at a distance of six feet at least from a dwelling-house or public building, or any building in which any person may be, or may be intended to be employed in any manufacture, trade or business.

Position of privies to allow removal of filth therefrom.

Every person who shall construct a privy in connection with a building, shall construct such privy in such a manner and in such a position as to afford ready means of access to such privy for the purpose of cleansing such privy and removing filth therefrom, and in such a manner and in such a position as to admit of all filth being removed from such privy, and from the premises to which such privy may belong, without being carried through any dwelling-house or public building, or any building in which any person may be or may be intended to be employed in any manufacture, trade or business.

Ventilation of privies.

Every person who shall construct a privy in connection with a building shall provide such privy with a sufficient opening for ventilation as near to the top as practicable, and communicating directly with the external air.

Floor of privies.

He shall cause the floor of such privies to be flagged or paved with hard tiles, or other non-absorbent material, and he shall construct such floor so that it shall be in every part thereof at a height of not less than *six inches* above the level of the surface of the ground adjoining such privy, and so that such floor shall have a fall or inclination towards the door of such privy of *half an inch to the foot.*

Privies with movable receptacles.

Every person who shall construct a privy in connection with a building, and shall construct such privy for use in combination with a movable receptacle for filth, shall construct over the whole area of the space immediately beneath the seat of such privy, a flagged or asphalted floor, at a height of not less than *three inches* above the level of the surface of the ground adjoining such privy; and he shall cause the whole extent of each side of such space between the floor and the seat to be constructed of flagging, slate, or good brick-work, at least *nine inches* thick, and rendered in good cement, or asphalted.

He shall construct the seat of such privy, the aperture in such seat, and the space beneath such seat, of such dimensions as to admit of a movable receptacle for filth of a capacity not exceeding *two cubic feet*, being placed and fitted beneath such seat, in such a manner, and in such a position, as may effectually prevent the deposit, upon the floor or sides of the space beneath such seat, or elsewhere than in such receptacle of any filth which may from time to time fall or be cast through the aperture in such seat.

He shall construct the seat of such privy so that the whole or such seat, or a sufficient part thereof, may be readily removed or adjusted in such a manner as to afford adequate access to the space beneath such seat for the purpose of cleansing such space, or of removing therefrom, or placing and fitting therein the appropriate receptacle for filth.

Privies with fixed receptacles.

Every person who shall construct a privy in connection with a building, and shall construct such privy for use in combination with a fixed receptacle for filth, shall construct or fix in, or in connection with such privy, suitable means or apparatus for the frequent and effectual application of ashes, dust or dry refuse to any filth which may from time to time be deposited in such receptacle.

He shall construct such receptacle so that the contents thereof may not at any time be exposed to any rainfall, or the drainage of any waste water, or liquid refuse from any adjoining premises.

He shall construct such receptacle of such material, or materials, and in such a manner as to prevent any absorption by any part of such receptacle, of any filth deposited therein, or any escape by leakage or otherwise of any part of the contents of such receptacle.

He shall construct such receptacle so that the bottom or floor thereof shall be in every part at least *three inches* above the level of the surface of the ground adjoining such receptacle.

He shall not in any case construct such receptacle of a capacity exceeding *eight cubic feet.*

He shall construct the seat of such privy so that the whole of such seat, or a sufficient part thereof, may be readily removed or adjusted in such a manner as to afford adequate access to such receptacle for the purpose of removing the contents thereof, and of cleansing such receptacle, or shall otherwise provide in or in connection with such privy adequate means of access to such receptacle for the purpose aforesaid.

Privies not to communicate with drains.

A person who shall construct a privy in connection with a building shall not cause or suffer any part of the space under the seat of such privy, or any part of any receptacle for filth in or in connection with such privy, to communicate with any drain.

Proximity of ash-pits to buildings.

Every person who shall construct an ash-pit in connection with a building shall construct such ash-pit at a distance of *six feet* at the least from a dwelling-house or public building, or any building in which any person may be, or may be intended to be employed in any manufacture, trade or business.

Proximity of ash-pits to water supply.

A person who shall construct an ash-pit in connection with a building shall not construct such ash-pit within the distance of (*thirty**) *feet* from any well, spring or stream of water used or likely to be used for drinking or domestic purposes, or for manufacturing drinks for the use of man, or otherwise in such a position as to render any such water liable to pollution.

Position of ash-pits to allow removal of contents therefrom.

Every person who shall construct an ash-pit in connection with a building, shall construct such ash-pit in such a manner, and in such a position as to afford ready means of access to such ash-pit for the purpose of cleansing such ash-pit, and of removing the contents thereof, and, so far as may be practicable, in such a manner and in such a position as to admit of the contents of such ash-pit being removed therefrom, and from the premises to which such ash-pit may belong, without being carried through any dwelling-house or public building, or any building in which any person may be, or may be intended to be employed in any manufacture, trade or business.

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* Thirty to forty feet is the distance usually inserted.

Capacity of ash-pits.

Every person who shall construct an ash-pit in connection with a building shall construct such ash-pit of a capacity not exceeding in any case *six cubic feet*, or of such less capacity as may be sufficient to contain all dust, ashes, rubbish, and dry refuse which may accumulate during a period not exceeding *one week* upon the premises to which such ash-pit may belong.

Construction of ash-pits.

Every person who shall construct an ash-pit in connection with a building shall construct such ash-pit of flagging, or of slate, or of good brick-work at least *nine inches* thick, and rendered inside with good cement, or properly asphalted.

He shall construct such ash-pit so that the floor thereof shall be at a height of not less than *three inches* above the surface of the ground adjoining such ash-pit, and he shall cause such floor to be properly flagged or asphalted.

He shall cause such ash-pit to be properly roofed over and ventilated, and to be furnished with a suitable door in such a position, and so constructed and fitted, as to admit of the convenient removal of the contents of such ash-pit, and to admit of being securely closed and fastened for the effectual prevention of the escape of any of the contents of such ash-pit.

Ash-pits not to communicate with drains.

Any person who shall construct an ash-pit in connection with a building shall not cause or suffer any part of such ash-pit to communicate with any drain.

Proximity of cesspools to buildings.

Every person who shall construct a cesspool in connection with a building shall construct such cesspool at a distance of (*fifty**) *feet* at the least from a dwelling-house or public building or any building in which any person may be, or may be intended to be employed in any manufacture, trade or business.

Proximity of cesspools to water supply.

A person who shall construct a cesspool in connection with a building shall not construct such cesspool within the distance of (*sixty*†) *feet* from any well, spring, or stream of water used, or likely to be used by man for drinking or domestic purposes, or for manufacturing drinks for the use of man, or otherwise, in such a position as to render any such water liable to pollution.

Position of cesspools to allow removal of contents therefrom.

Every person who shall construct a cesspool in connection with a building shall construct such cesspool in such a manner, and in such a position, as to afford ready means of access to such cesspool for the purpose of cleansing such cesspool, and of removing the contents thereof, and in such a manner and in such a position as to admit of the contents of such cesspool being removed therefrom, and from the premises to which such cesspool may belong, without being carried through any dwelling-house or public building, or any building in which any person may be, or may be intended to be employed in any manufacture, trade, or business.

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* Minimum distance usually inserted.

† Sixty to eighty feet should be the minimum distance from any water-supply.

Cesspools not to communicate with drains.

He shall not in any case construct such cesspool so that it shall have, by drain or otherwise, any outlet into, or means of communication with any sewer.

Construction of cesspools.

Every person who shall construct a cesspool in connection with a building shall construct such cesspool of good brick-work in cement, properly rendered inside with cement, and with a backing of at least nine inches of well-puddled clay around and beneath such brick-work.

He shall also cause such cesspool to be arched, or otherwise properly covered over, and to be provided with adequate means of ventilation.

Removal of snow from footways, &c.

For the prevention of nuisances arising from snow, filth, dust, ashes, rubbish, the occupier of any premises fronting, adjoining, or abutting on any street shall, as soon as conveniently may be after the cessation of any fall of snow, remove or cause to be removed from the footways and pavements adjoining such premises all snow fallen or accumulated on such footways and pavements in such a manner and with such precautions as will prevent any undue accumulation in any channel or carriage-way or upon any paved crossing.

Removal of snow from premises.

Every person who shall remove any snow from any premises on to any carriage-way shall deposit the same in such manner, and with such precautions, as to prevent any undue accumulation thereof in any channel, or carriage-way, or upon any paved crossing. If in the process of such removal any snow be deposited upon any foot-way or pavement in any street, he shall forthwith remove such snow from such footway or pavement.

As to the mixing of salt with snow.

Every person who for the purpose of facilitating the removal of any snow from any foot-way or pavement, shall throw salt upon such snow, shall forthwith effectually remove from such footway or pavement the whole of the deposit resulting from the mixture of the salt with the snow.

Construction of premises for cattle, swine, &c., scavenging, &c.

Every occupier of a building or premises wherein, or whereon, any horse or other beast of draught or burden, or any cattle or swine may be kept, shall provide in connection with such building or premises a suitable receptacle for dung, manure, soil, filth, or other offensive or noxious matter, which may from time to time be produced in the keeping of any such animal in such building, or upon such premises.

He shall cause such receptacle to be constructed so that the bottom or floor thereof shall not in any case be lower than the surface of the ground adjoining such receptacle.

He shall also cause such receptacle to be constructed in such a manner and of such materials, and to be maintained at all times in such a condition as to prevent any escape of the contents thereof, or any soakage therefrom into the wall of any building.

He shall cause such receptacle to be furnished with a suitable cover, and when not required to be open to be kept properly covered.

He shall likewise provide in connection with such building or premises a sufficient drain, constructed in such a manner and of such materials and maintained at all times in such condition as effectually to convey all urine or liquid filth, or refuse therefrom into a sewer, cesspool, or other proper receptacle.

## (D.) METROPOLIS WATER ACT, 1871.

The following regulations under the above Act relate to the arrangement of water-closets, urinals, &c., and are consequently of importance to householders in the metropolis :—

Boilers, water-closets, and urinals, to have cisterns.

Every boiler, urinal, and water-closet, in which water supplied by the company is used (other than water-closets in which hand-flushing is employed), shall within three months after these regulations come into operation be served only through a cistern or service-box and without a stool-cock, and there shall be no direct communication from the pipes of the company to any boiler, urinal, or water-closet.

Water-closet apparatus.

Every water-closet, cistern, or water-closet service-box hereafter fitted or fixed, in which water supplied by the company is to be used, shall have an efficient waste-preventing apparatus, so constructed as not to be capable of discharging more than two gallons* of water at each flush.

Urinal-cistern apparatus.

Every urinal-cistern in which water supplied by the company is used, other than public urinal-cisterns, or cisterns having attached to them a self-closing apparatus, shall have an efficient "waste preventing" apparatus, so constructed as not to be capable of discharging more than one gallon of water at each flush.

Water-closet down pipes.

Every "down pipe" hereafter fixed for the discharge of water into the pan or basin of any water-closet, shall have an internal diameter of not less than one inch and a quarter, and if of lead shall weigh not less than nine pounds to every lineal yard.

Pipes supplying water-closets to communicate with cistern only.

No pipe by which water is supplied by the company to any water-closet shall communicate with any part of such water-closet, or with any apparatus connected therewith, except the service cistern thereof.

Baths to be without overflow pipe.

No bath supplied with water by the company shall have any overflow waste-pipe, except it be so arranged as to act as a warning-pipe.

Bath apparatus.

In every bath hereafter fitted or fixed the outlet shall be distinct from, and unconnected with, the inlet or inlets, and the inlet or inlets must be placed so that the orifice or orifices shall be above the highest water level of the bath. The outlet of every such bath shall be provided with a perfectly water-tight plug, valve, or cock.

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* As already mentioned, this flush is totally inadequate.

## (E.) INSTRUCTIONS TO PLUMBERS ISSUED BY THE NEW RIVER COMPANY.

### REQUIREMENTS AS TO FITTINGS.

A. "*Communication pipe*" (that is, the pipe for communication between the Company's pipe and the premises to be served) must be placed as the Company approve, and no house shall have more than one "communication pipe," or have connection with the "fittings" of any other house.

B. *Weights of lead pipes* shall be, at least, as under, with the further condition that every pipe shall have an equal thickness of metal throughout :—

| Internal Diameter. | Weight in lbs. per Lineal Yard. | |
|---|---|---|
| | Pipes subject to pressure. | Pipes having open ends. |
| $\frac{3}{8}$ inch | 5 | — |
| $\frac{1}{2}$ ,, | 6 | 3 |
| $\frac{5}{8}$ ,, | $7\frac{1}{2}$ | — |
| $\frac{3}{4}$ ,, | 9 | 5 |
| 1 ,, | 12 | 7 |
| $1\frac{1}{4}$ ,, | 16 | 9 |

C. "*The connections*" of "communication pipes" with any pipes of the Company will in each case be made by the Company's workmen, by means of a good brass screwed ferrule or stop-cock with union, after all the costs reasonably chargeable for such "connection" shall have been paid to the Company by the applicant for the supply.

. *Lead pipe joints* must be of the kind called "plumbing" or "wiped" joints.

. *Arrangement of lead pipes* must be such that no lead pipe—

(1) be at a less depth, in open ground, than two feet six inches below the surface.

(2) or pass through any drain or place from which impurity may be contracted.

(3) or be left in any exposed situation without sufficient protection against frost.

(4) or communicate with any rain-water receptacle.

F. *Stop-valve.*—Every "communication pipe" shall have (near the point of its entrance into the premises for which it has been provided) a good "screw-down" stop-valve, and this valve (if in the ground) must be protected by a proper cover and guard-box.

G. *Cisterns* must—

(1) have suitable metallic lining if of wood.
(2) be perfectly watertight.
(3) be properly covered.
(4) be not buried.
(5) be so placed as to be readily inspected and cleansed.
(6) be each furnished with a substantial and efficient valve ball-tap, firmly attached to a securely-fixed inlet pipe, and so set that its ball (which must be of copper) may not become submerged, or allow water to rise within two inches of the level of the lower side of any connected overflow outlet.

H. *Waste pipes*, other than "warning pipes," will not be allowed in connection with cisterns or baths, and all "warning pipes" must be so placed as to admit of their discharge being readily seen.

Every connection of an "air-pipe" with cistern, service box, or bath is hereby forbidden.

I. *Draw taps* must be of good design and substantially made. They must be of the "screw-down" kind, or otherwise so constructed (if of the "self-closing" kind) that they shall act without concussion.

For obtainment of direct supply from the Company's pipes, a draw tap may be fixed on the supply pipe of any house.

Every draw tap on any outside stand pipe must be of the "waste-preventer" kind, and must be well protected against frost, theft, and mischief.

K. *Water-closets* can be served only through cisterns or "service boxes"; and no water-closet can be allowed to be put in connection with any cistern or service box unless the same shall be provided with an efficient "waste-preventing apparatus," so constructed as not to be capable of discharging more than two gallons of water at each flush.

Every "down pipe," to be fixed to any water-closet, must have an internal diameter of not less than one inch and a quarter.

All "stool cocks" are strictly prohibited.

L. *Urinals* can be served only through cisterns, and no urinal-cistern can have supply unless it be provided with an efficient "self-closing" arrangement or "waste-preventing apparatus," so constructed as not to be capable of discharging more than one gallon of water at each flush.

M. *Boilers* can be served only through cisterns.

N. *Baths*, to be fitted or fixed, must have their pipe connections so arranged—

(1) that every "inlet" shall be distinct from the "outlet," and so placed as to have its orifice above the highest water level of the bath; and

(2) that every "outlet" shall be provided with a perfectly watertight plug, valve, or cock.

N.B.—Those forms of bath apparatus which (while fulfilling the above conditions) do not allow "inlet" and "outlet" to be open together are always to be preferred.

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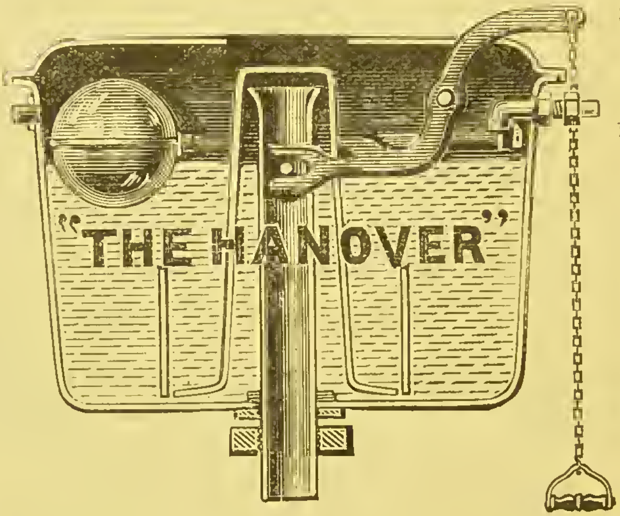

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